VOL. 35, NO. 11 NOVEMBER, 1958

AMERICAN JOURNAL OF OPTOMETRY *and* ARCHIVES *of* AMERICAN ACADEMY OF OPTOMETRY

EDITOR
CAREL C. KOCH

EDITORIAL COUNCIL
MEREDITH W. MORGAN, JR. Chairman
ROBERT E. BANNON
IRVIN M. BORISH
RUDOLPH EHRENBERG
V. J. ELLERBROCK
GLENN A. FRY
MONROE J. HIRSCH
HENRY W. HOFSTETTER
OSCAR L. MCCULLOCH
BERNARD MAZOW
HERMAN SAGER
MAX SCHAPERO
DONALD A. SPRINGER
KENNETH B. STODDARD
RALPH E. WICK
JOHN ZETTEL

CONTENTS

ORIGINAL PAPERS

Some Recent Research on Visual Problems in Reading.
Charles B. Huelsman 559

Night Driving Seeing Problems.
Oscar W. Richards 565

A Method of Fitting Contact Lenses and Correcting Aphakia.
A. Harry Malin 580

Studies in Fixation Disparity.
Darrell B. Carter 590

Accommodation Levels During Near Crossed-Cylinder Tests.
Gerald Westheimer 599

EDITORIAL

Academy Post-Graduate Course—1958.
V. J. Ellerbrock 605

TRANSACTIONS OF THE ACADEMY

The Program. Annual Meeting, American Academy of Optometry, Boston, December 13, 14, 15, 16, 1958 at the Statler Hilton Hotel.
Ralph E. Wick 609

CURRENT COMMENTS

Opportunity for Naval Reserve Commission.
Terry Judith Parkins 612

Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION, 1508 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

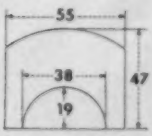
ANNUAL SUBSCRIPTION, UNITED STATES and CANADA $8.00; FOREIGN $9.00.
Single Copies, 80c

Entered as second-class matter, February 20, 1924, at the post office at Minneapolis 2, Minnesota, under the Act of March 3, 1879.
Established 1924.

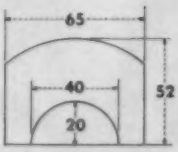
ONE SOURCE... *FOR YOUR MULTIFOCAL NEEDS!*

Those, sir, are magic words that spell real *convenience!* Think of it! You can meet the requirements of practically ALL your multifocal needs by simply choosing from Continental's wide, wide selection of first quality bifocals and trifocals. One source! Look at them! No wonder so many professionals prefer to order *exclusively* from Continental's complete and all-inclusive multifocal line. It's so easy . . . and satisfying!

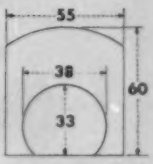
THE ULTEX SERIES



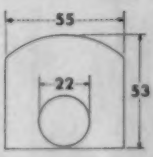
ULTEX A



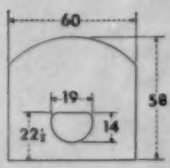
ULTEX A
King Size Corrected



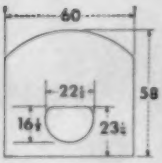
ULTEX AL (AA)



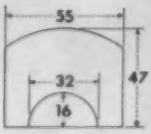
ULTEX B



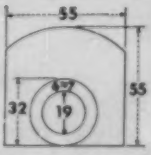
ULTEX K—19 m/m



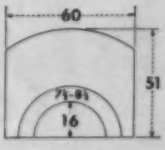
ULTEX K—22½ m/m



ULTEX E

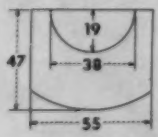


ULTEX T
50% Intermediate



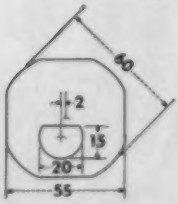
ULTEX X
50% Intermediate

ULTEX CATARACT
Lenticular

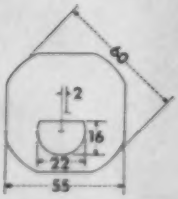


REDE-RITE

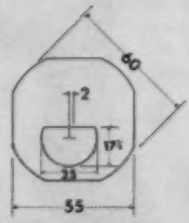
THE KUROVA FUSED AND ONEPIECE SERIES



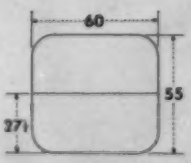
KUROVA F—20 m/m



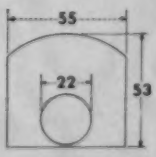
KUROVA F—22 m/m



KUROVA F—23 m/m



KUROVA M
Straight Line



KUROVA D
ONEPIECE

Continental
INDIANAPOLIS

NEW TOP HIT BY ART-CRAFT

CLUBMAN
ART/RIM

Brown and Pink

Black and White

Grey Slate

Blackwood

Redwood

Briartone

PROPORTIONATE STYLING

ART-CRAFT

Contributing to the Science of Beauty

ART-CRAFT OPTICAL CO., INC.
MANUFACTURER
P.O. BOX 1908 • ROCHESTER 3, N. Y.

DISTRIBUTED BY

ART CRAFT OPTICAL OF NEW YORK CITY, INC.
ART CRAFT OPTICAL OF PHILADELPHIA, INC.
CHICAGO ART CRAFT OPTICAL, INC.
ART CRAFT OPTICAL OF NEW ENGLAND, INC.
ART CRAFT OPTICAL-MIDWEST, INC.
ART CRAFT OPTICAL-SOUTHEAST, INC.
ART CRAFT OPTICAL-WEST COAST, INC.
ART CRAFT OPTICAL OF THE SOUTH, INC.
NORTH CENTRAL ART CRAFT OPTICAL, INC.
ART CRAFT OPTICAL OF ROCHESTER, INC.
ART CRAFT OPTICAL-MIDDLE ATLANTIC, INC.
ART CRAFT OPTICAL-SOUTHWEST, INC.
ART CRAFT OPTICAL OF CANADA, LTD.
ART CRAFT OPTICAL-INTERAMERICANA, INC.
ART CRAFT OPTICAL EXPORT CORP.

PANOPTIK is the

because only **PANOPTIK** has all

of natural vision...

1

Jumpless passage from near point to far vision. Proximity of optical centers virtually eliminates displacement, makes Panoptik the "easiest to get used to" bifocal.

2

Balanced viewing The greatest reading width is at the top where it is needed, yet segment is so shaped as to retain maximum area in the distance field.

3

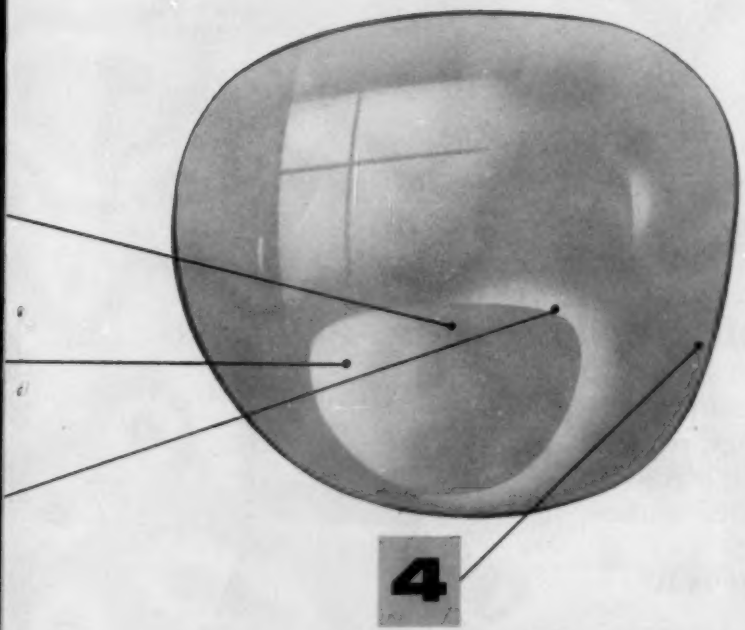
Ease of seeing There are no straight lines or sharp corners in the natural cone of vision . . . nor in the Panoptik segment! Round corners and gently lifted top line minimize reflections, are pleasing in appearance, always recognizable.

NEW! HELPS YOU INTERPRET THE BIFOCAL STORY

Just off the press, a new visual aid to patients' understanding of presbyopia, and the benefits to be derived from your services in prescribing and fitting modern natural vision bifocals. Use it in refracting room, at fitting table—or for patients' perusal in reception room. Ask your supplier for a copy.

"natural vision" bifocal

the BIG 4 FEATURES



Full, clear wide-angle vision
is a benefit of exclusive Orthogon corrected curves . . .
in premium quality B&L ophthalmic glass . . .
and in a full range of needed powers and adds.

Standardize on Panoptik.
. . . in white, Soft-Lite
and Ray-Ban.

BAUSCH & LOMB
SINCE 1853

Occupational Vision Begins at Home

In hobbies or work about the home in this do-it-yourself age, many of your patients are just as exposed to eye hazards as industrial workers.

Whose Responsibility Is It?

Chances are your patients are unconscious of these "home grown" hazards. Does your patient history investigation explore this vital area of functional vision?

Based upon real need, prescribing for protection in addition to correction is a rewarding area of service for the practitioner.

Suggestion: Set an example. Wear safety glasses in your own avocations where eye hazards may occur.

New Safety Eyewear Kit now available

Now Titmus puts the practitioner in position to assume his proper role in Occupational Vision, with a line of safety eyewear available only on professional recommendation. Write today for information.

MANUFACTURER — INDEPENDENT SUPPLIER — PRACTITIONER

"The Golden Link to Complete Service"

TITMUS OPTICAL COMPANY, INC.
PETERSBURG, VIRGINIA

Use PC quality **Nonscleral®** Contact Lenses with complete confidence— now licensed under litigated Patent No. 2,510,438

(Covering the original concept of corneal-type lenses)

THERE'S NO CHANGE in the outstanding quality of PC's dependable **Nonscleral** Lenses. And there's no change in the consistent, high-quality workmanship and know-how developed by PRECISION-COSMET — *pioneers in the manufacture of quality contact lenses for 15 years!*

- **Rely on PC's Consistent Uniformity of Lens Curves** — repeatability of curvatures is accurately maintained.
- **Use PC's Simplified Fitting Techniques**
- **Enjoy Complete Patient Satisfaction**

WRITE TODAY for PC's free illustrated literature —
"Simplified Fitting Techniques" technical manual
"Facts and Tips" patient question and answer folder
"Care and Handling" patient instruction folder

Recently-expanded space and increased production facilities now assure you of the finest service available.

Remember: when you specify PC **Nonscleral** Lenses, you assure the patient of the finest in quality optics!

On your next contact lens Rx, specify PC NONSCLERAL Lenses with full assurance . . .

Precision-Cosmet Co. Inc.

529 SOUTH SEVENTH ST. • MINNEAPOLIS 15, MINNESOTA

Other Quality PC Products – *P-28* and *Cen-Cor Multifocals* • *Lens Hardening Unit* • *Take-Off Chiller* • *Precision Inspectoscope* • *Glass-Gard* • *Adjusta-Bridge* • *Comfo-Bridge* • *Cosma-Kleen* • *P.D. Lite & Meter* • *Child's Trial Frame* • *Plastic Artificial Eyes* • *Allen Implant*

RON

DEAN IN NEW DUSK COLORS

Here is something new for men, a new use of light and shade and color in the Dusk Grey and Dusk Brown colors in both Rondean and Rondean Clear Bridge . . .

Dusk Grey and Dusk Brown are attractive masculine colors which have been given the added interest of "changeability" by the incorporation of a *natural pearl essence*, causing the basic colors to change subtly according to the way the light strikes. And, there is just enough translucence to "blend" temples and fronts in with hair and complexions.

Rondean's shape has demonstrated its popularity—on both sides of the fitting table. Its smart contemporary styling, with foreshortened endpieces, combines character with comfortable weight. Its modified keyhole bridge facilitates fitting for easy wear.

Now both solid and clear bridge styles in your choice of five colors—Dusk Grey, Dusk Brown, Briar Grey, Black Briar and Golden Briar. In a full range of sizes—44, 46 and 48 with 18 to 24 bridge; 50 with 20 to 24. With matching Academy Temples (shown) from 5¼" to 6½" in all five colors; straight library Imperial Temples (from 5½" to 6¼", in the three "briars").

To sum up, something new, different and smartly masculine . . . in solid or clear bridge . . . with a broad range of sizes and colors for men of every age, every type and taste.

SHURON OPTICAL COMPANY, INC. SHURON Geneva, N. Y. Rochester, N. Y.

what is... PEK?

PHOTO ELECTRONIC KERATOSCOPY

...See it in November

...at the

3rd National Contact Lens Congress

New York: November 2-3, Roosevelt Hotel

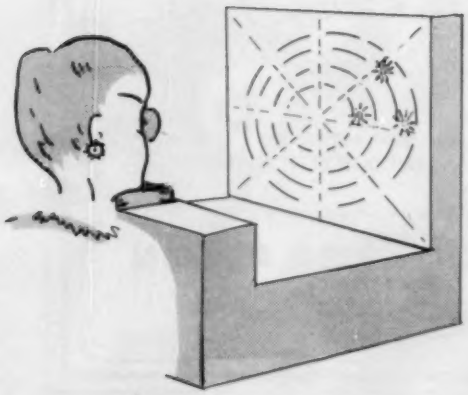
Chicago: November 9-10, Hotel Sherman

San Francisco: November 16-17, Sheraton Palace Hotel

THE NEW

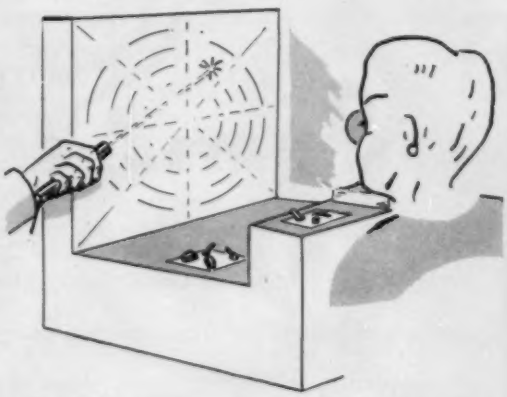
MULTIPLE TARGET SCREENER

MODEL GII IS TWO IN ONE



Multiple Target Screener. The patient simply fixes his attention on a small red dot shining in the center of a tangent screen and moves his chin in a rest until a ring (corresponding to the normal blind spot) disappears. That's all! The patient is ready for testing. He is instructed to continue to look at the center target while a series of test points are shown, and is asked to tell how many dots he sees each time they are flashed. Any missed are noted on a score sheet. The occluder is moved to the other eye, and the procedure repeated. The answer to glaucoma in less than 3 minutes.

TACHISTOSCREEN.* A brand new technique – flick a switch and the screener becomes a diagnostic instrument. A 2/330 illuminated target may be used separately or with the standard Multiple Target test. Most important, it is synchronized with the fixation target and blind spot marker. A unique arrangement insures complete accuracy of alignment, but eliminates all fixation points at the moment of testing. An ideal combination of the tachistoscope and standard tangent screen.



Price includes check sheets and complete instructions. Fully guaranteed against defective workmanship. FOB factory.

ONLY $115.00

ORDER THROUGH YOUR LABORATORY

The ROBERTS' INSTRUMENT COMPANY

Incorporated

MOBERLY, MISSOURI

* Trademark

Prices subject to change without notice

THERMINON: AN ABSORPTIVE LENS
Scientifically formulated to absorb infra-red radiations.

THERMINON: AS A FILTER
To filter out ultra violet and irritating red rays.

THERMINON: FOR HIGH TRANSMISSION OF WHITE LIGHT
Actually a cooler sensation is produced.

THERMINON: ALL LENSES ARE RADII CORRECTED
Corrected curves.

When you prescribe Genuine Therminon you give your patient the maximum in seeing comfort and your patient will report SUPERIOR EFFECTIVENESS.

All reliable laboratories can fill your Therminon needs, or write

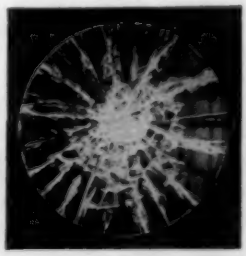
THERMINON LENS CORPORATION

63rd & University • Des Moines, Iowa

MOTEX
T.M. REG. U.S. PAT. OFF.

LAMINATED SAFETY LENSES

...continue to provide the most positive *and* practical Eye Protection available — just as laminated safety glass continues to provide protection in today's automobiles — cars with greater glass area than ever before. Motex Construction holds fragments intact if lenses are accidentally broken while in position before the eyes.



OPTICAL INDUSTRIES, INC.

1701 GENT AVENUE

INDIANAPOLIS INDIANA

NOW IT'S YOUR TURN, DADDY!

Another Spirited Breadwinner Who Refuses To Part With His Comfortable Par Saddle!

Looks like Dad can't wait to pin the tail, but notice — he's playing the game according to his own rules — that he be allowed to continue wearing his glasses! It's no wonder, for that's Liberty's *Par Saddle 325* he has on. And once a Par Saddle wearer — *always* a Par Saddle wearer; it's that comfortable!

Ask your supply house representative to show you the 325, available in *solids, two-tones* and *clearbridges,* in a wide variety of masculine colors.

LIBERTY

Newark 2, N. J.

Recommended reading: GUIDE TO OCCUPATIONAL AND OTHER VISUAL NEEDS by Clark Holmes. (Available through A.I.O.W., Chicago, Ill.)

NEW STARS from

A TOUCH OF LUXURY

CALIFORNIA SADDLE LEATHER...rich, soft, natural. A new AO luxury case for those who know and love fine leather . . . California Saddle, available nationally for the first time through AO . . . There is no finer leather . . . Mellows with age to a rich, golden beauty . . . Soft, chamois-like leather lining prevents scratching . . . In six styles for men and women . . . Your imprint BRANDED or gold stamped . . . **priced from $53 per 100.**

14-3 WWL
Gusset for Women

132R-3 WWL
Combination Reinforced Case

S185-2 WWL
Slip-in
Open End

15-3 WWL
Gusset for Men

187-1 WWL
One-piece
Open End

LC187-1 WWL
One-piece
Open End
with Clip

the complete AO case line

. . . A CASE FOR ECONOMY

Cat. No. 30R-3MAV

CENTURION . . . Colorful, durable vinyl. A new AO budget beauty case for giveaway . . . Long-wearing vinyl finished in arctic seal grain, forecast as the popular leather finish for 1959. Steel wrap-around inner shield for complete lens protection. Polyethylene nose-block positions frame securely . . . Scratch-proof, taffeta finish inner lining . . . Attractive, long wearing . . . In five eye-catching colors: Red, Blue, Cordovan, Ginger, White . . . **$16 per 100** (*10% additional discount for 1,000 quantity*)

RED BLUE CORDOVAN GINGER WHITE

American Optical

COMPANY

SOUTHBRIDGE, MASS.

Since 1833 . . . Better Vision for Better Living

provide protection for your athlete-patients

with the ALL-NEW

ALL AMERICAN©

ATHLETIC GLASSES

Streamlined ends to protect other players
Expandable, adjustable "Glass Gard" headband
"Cushion Fit" shock absorbent rubber nose piece
Special contoured lenses to fit face
Extra deep eye-wire channel to hold lenses securely
Drop-ball tested safety glass or plastic lenses

ALL-NEW SAFETY DESIGN!

• ALL AMERICAN ATHLETIC GLASSES are a wise investment in eye safety for athletes. These all-new glasses have been designed by BENSON to provide the finest in protection without interfering with performance . . . *assuring complete player confidence!* Note the specific design features above — and you'll agree that your athlete-patients who wear glasses deserve this kind of all-around protection.

Advertisements reaching thousands of athletic coaches and athletes around the country will advise *"Order through your doctor."* Be ready — examine a complete sample at nominal cost. *Write today . . .*

JOHNNY KUNDLA, coach of the *Minneapolis Lakers*, says — *"All American Athletic Glasses provide the utmost in eye protection!"*

•

SIZES

44-20 47-20
44-23 47-23

Temples available from 6" through 7" cable.

BENSON OPTICAL COMPANY

Executive Offices • Medical Arts Building, Minneapolis

specialists in prescription optics since 1913

COMPLETE LABORATORIES CONVENIENTLY LOCATED IN UPPER MIDWEST CITIES

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY

Vol. 35 November, 1958 No. 11

SOME RECENT RESEARCH ON VISUAL PROBLEMS IN READING*

Charles B. Huelsman†
School of Education, Miami University
Oxford, Ohio

Practitioners in optometry and in education have recently been paying attention to research into the field of vision as it affects reading. Some of the research makes rather exorbitant claims for its findings. Other research implies quite strongly that these claims are unsound. It is our purpose in this paper to examine carefully some of the recent research that is controversial in character.

Currently, the author is preparing a series of summaries of the research in vision and learning published since 1932. The present paper, however, will be limited to the research published since 1950 from which specific studies have been selected. Twenty-one studies were considered and nine were selected for inclusion in the paper. The studies have been organized under three headings: (1) studies related to outline form perception, (2) studies related to the use of the tachistoscope, (3) studies related to general visual achievement.

OUTLINE FORM PERCEPTION

Two studies that investigated outline form perception were considered in detail. Both are unpublished since they are in one case a disseration and in the other case a thesis. The disseration, by Lowder, was accepted by Purdue University in June, 1956. Lowder's[5] subjects were 1510 first, second, and third grade children representing the entire population at the Winter Haven, Florida, public schools. Evidence of skill in outline form perception was obtained by having the children copy a circle, a cross, a square, a triangle, a divided rectangle, and horizontal and vertical diamonds. The children were tested four at a time by the same person. Scoring was done by the author and by a number of raters. The children's performances were rated as high, average, or low for each of the seven forms. Assigning scores of 3, 2, and 1 points, the total scores (varying from 7 to 21) in outline form perception skill were

*Read before the annual meeting of the American Academy of Optometry, Section on Orthoptics, Chicago, Illinois, December 9, 1957. For publication in the November, 1958, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Associate Professor of Education. Fellow, American Academy of Optometry.

obtained for each of the children. The measurement of school achievement was obtained by asking the teachers to rate the children as high, average, or low. Apparently, some measure of intellectual capacity was used, although Lowder neglected to describe how this was done. Lowder found coefficients of correlation between the outline form perception and school achievement that varied from +0.43 to +0.57 in individual grades. These correlation coefficients dropped slightly when either mental age or chronological age was held constant. Lowder concluded that there was a significant relationship between perceptual ability and school achievement.

Kosiba's[4] thesis was accepted by Miami University in August, 1957. His subjects were 77 students representing the total fifth grade at Fairfield North Elementary School in Ohio. The children were given the *Lorge-Thorndike Intelligence Test*, *The Chicago Reading Test* C_1, *The SRA Reading Analysis-Aptitude and Achievement* sections, form A, the *Children's Visual Achievement Forms*, *The Benton Visual Retention Test*, form C, and the *Bender Visual Motor Gestalt Test*. He found a correlation coefficient of —0.09 between the *Children's Visual Achievement Forms* and the *Chicago Reading Test* total comprehension score. The correlation coefficients between the *Children's Visual Achievement Forms* and the sub-tests of the *SRA Reading Analysis, Achievement* section ranged from +0.08 to +0.19. He concluded that these data demonstrated no relationship between reading achievement and outline form perception at the fifth grade level as measured by the *Children's Visual Achievement Forms*. However, in considering the Benton and the Bender against reading achievement test scores, he found significant coefficents of correlation (+0.35 to +0.38) with the *Chicago Reading Test* as well as with some of the sub-tests of the *SRA Reading Analysis, Achievement and Aptitude* sections (+0.19 to +0.45). These coefficients of correlation, however, were reduced to near zero when intelligence (as measured by the Lorge-Thorndike) was held constant in a partial correlation.

These two studies are not directly comparable since one is done at the early primary level and the other at the fifth grade level. Nonetheless, Kosiba's study strongly implies the need for a re-evaluation of Lowder's findings, especially the finding that reveals only a slight lowering of the correlation coefficient when mental age is held constant.

Kosiba's findings are more in line with those of Robinson and Huelsman[7] who determined that form memory was not associated with reading achievement at the fourth and seventh grade levels, both when intelligence was held constant and when it was not. Too, Kosiba

scored the *Children's Visual Achievement Forms* in accordance with the test directions rather than high, average and low. Another difference between the two studies lies in the fact that Kosiba used standardized tests to measure achievement and mental age and did not depend upon teachers' opinion.

Fabian's[2] study may also shed some light on Lowder's findings. He examined 20 third grade public school children who were selected from among 210 children as having an IQ of 85 or better and who were below the first quartile in reading. He used routine physical and neurological examinations, psychiatric interviews, and the Bender, Goldstein-Scheerer, and Goodenough tests. He concluded that reading retardation is a symptom of an underlying individual, and sometimes familial, psychopathology. He considered the learning disability to be one of many symptoms shown by these ego disabled, emotional retarded, infantile, dependent children. He indicated that the infantile child retains infantile habits of perception and visual-motor performance.

If Lowder's findings are considered in relation to Fabian's, we would be forced to investigate whether or not outline form perception and reading achievement were related to one another only by means of some other, probably psychopathological, factor.

The consideration of these studies reveals quite clearly the controversial character of the research and the necessity of considering any conclusions regarding outline form perception skill as it is related to reading achievement as tentative. It is obvious that another and a carefully controlled study is needed.

TACHISTOSCOPIC TRAINING

We may get some idea of the claims, counter-claims and implications in regard to tachistoscopic training if we consider studies by Manolakes (1952) and Walton (1955). Walton[9] worked with 56 adults giving training in both reading rate and visual perception, meeting each of three groups twelve times for a total of twenty-four hours. Each session included a fifteen minute lecture, visual training (using the stereomotivator or the Keystone tachistoscope), a Harvard reading film, a visualization exercise, a vocabulary exercise, tachistoscopic training for twenty minutes, and a timed reading exercise. Walton indicated that the subjects moved from four to seven digits and from two to five words in tachistoscopic training and from 232.8 words per minute with 77.5% comprehension to 417.0 with 82.1% comprehension. Walton had no control group. Walton does not conclude that there is a causal relationship between tachistoscopic training improvement and improvement in reading rate. He only places them parallel, noting that they

improved together.

Manolakes,[6] on the other hand, worked with 34 adults whom he divided into an experimental group and a control group. The control group pursued the regular Marine Corps instructional program that involves the use of the reading rate controller, the tachistoscope, and vocabulary and comprehension exercises. The experimental group was taught without the tachistoscope and this time was used in additional vocabulary and comprehension training. His results showed total group gains that were significant in reading rate, fixations, regressions, and span of recognition. There was no change in duration of fixation. The experimental group exceeded the control group in reading rate, at a significant level. However, he found no difference between the experimental and control groups in fixation, regressions, span of recognition, or duration of fixations. He concluded that the experimental group was not penalized by the lack of tachistoscopic training and that, therefore, any improvements in visual skills measured by the ophthalmograph may be the result of improvement in reading efficiency rather than a contributor to the improvement in reading.

These studies certainly imply strongly the need for a more careful evaluation of tachistoscopic techniques before further claims are made that they result in improvement either in some learned skill or in the potential to learn a skill.

GENERAL VISUAL ACHIEVEMENT

Studies in this area were published in 1952 by Sabatini, in 1953 by Edson, Bond, and Cook and by Robinson and Huelsman, and in 1955 by Haines. Sabatini,[8] using Chicago school children, assigned one point value to each test in the vision battery. Children who failed no tests were given a zero score; those who failed one test were assigned a score of one; those who failed two tests were given a score of two, and so on. He found a coefficient of correlation of $+0.485$ between vision and an achievement quotient, computed from the reading achievement and mental age scores supplied by the school teachers. He did not correct the coefficient for the curvilinear relationship.

Edson,[1] on the other hand, concluded that there was no significant relationship between any of a set of thirteen vision test scores and any of a group of ten reading test scores. He found that myopic children have higher reading achievement scores than non-myopic children. The findings in terms of the other visual aspects, however, were similar; that is, no real difference in reading achievement between visual defect groups and groups with normal vision was identified.

Edson's findings and those of Robinson are quite similar. Robin-

son[7] reported that intercorrelations between individual reading tests and individual vision tests revealed very slight and inconsistent relationships. Robinson used a number of statistical procedures. She compared high and low achievers and found that only tests of binocular functions distinguished between the two groups with any degree of consistency. The use of cut off points and the use of Sabatini's technique produced no statistically reliable relationship. Partial correlations (with intelligence held constant) did not change any of the relationships. Group factor analysis (centroids) pointed out a relationship between composite reading achievement on one hand and near acuity and depth perception tests on the other hand. Robinson also pointed out a number of limitations of the research at that time. (1) Assumptions were made regarding reliability and validity of visual screening tests. (2) Assumptions were made regarding the adequacy of norms and their use with children. (3) Visual characteristics of many of the studies were limited to those measured in screening tests. (4) The reports did not adequately describe the subjects. (5) There were sampling errors. (6) Results were frequently based on too few subjects. (7) Mental tests used were those that required reading to indicate reading expectancy. (8) Statistical analysis was frequently inadequate.

Haines' study[3] is also in contrast to that of Sabatini. He has reported a longitudinal study of 37 children, having "lost" only one during the seven years of the study. Half of the children began in grade one and the other half in grade two completing their period of "service" at the eighth and ninth grade level. Visual examinations were given first, last, and one to three times in between. All children were given Stanford-Binets at grade three. Results of standardized achievement tests administered by the school were used. Haines points out the following: (1) Eleven of the group had normal vision throughout the period and only one of them was seriously retarded academically (in arithmetic). (2) Three of the group had good initial visual skills but developed visual problems. One of them, a boy, was slow in developing reading skills. (3) Eight of the group had initial visual problems that improved. Their academic achievement was slow to start and erratic in its development. (4) Sixteen of the 37 had visual problems throughout the seven years. Eight were girls and eight were boys. Seven of the eight girls were at the norm or above the norm academically. However, they tended to withdraw from other school activities. Nine of the sixteen were retarded in reading, arithmetic, or both. (5) A first or second grade child with a hyperopic reserve of one to one and one-half diopters will approach the secondary school with normal acuity or with

low hyperopia. (6) A child with no hyperopic reserve will tend to be myopic at that point. (7) Esophoria at near appears to be a danger signal for visual and possibly reading disability.

Haines' study, in contrast with the other three, appears to be more analytical and definitive in its conclusions. It would appear that longitudinal studies may be more effective in producing new knowledge than cross-sectional or single level studies.

CONCLUSIONS

By bringing these nine studies into focus, the author has hoped to show the contrasts and controversies apparent among recently published research on the interaction between visual skills and learning to read. The conclusions and implications differ widely: claiming that outline form perception skill *is* and *is not* related to learning to read, that tachistoscopic training *does* and *does not* contribute to attaining a more rapid reading rate, and that visual skills generally *are* and *are not* related to learning to read.

The research-consuming public should not be discouraged by these contrasts in conclusions and in the techniques of the research. It is vital in this field that all avenues be explored in many different ways. Obviously many of the avenues will turn out to be blind alleys, but it is only by exploring them all that we will eventually arrive at the truth. It is discouraging, however, that there are so few studies in the literature and available to the consuming public.

REFERENCES

1. Edson, William H., Guy L. Bond, and Walter W. Cook. Relationships between visual characteristics and specific silent reading abilities. J. Educ. Research, 46: 451-457, 1953.
2. Fabian, Abraham A., Clinical and experimental studies of school children who are retarded in reading. Q. J. Child Behavior, 3: 15-37, 1951.
3. Haines, Howard. An evaluation of the visual status and academic achievement of a selected group of elementary school children over a period of seven years. Am. J. Optom. and Arch. Am. Acad. Optom., 32 (6): 279-288, 1955.
4. Kosiba, Raymond J., The Relationship Between Outline Form Perception and Reading Achievement at the Fifth Grade Level (Unpublished Masters Thesis). Oxford, Ohio, Miami University, August, 1957.
5. Lowder, Robert Glenn, Perceptual Ability and School Achievement: an Exploratory Study (Unpublished Doctoral Dissertation). Lafayette, Ind., Purdue University, June, 1956.
6. Manolakes, George. The effects of tachistoscopic training in an adult reading program, J. Applied Psych., 36: 410-412, 1952.
7. Robinson, Helen M. and Charles B. Huelsman, Jr., Visual efficiency and progress in learning to read, in Clinical Studies in Reading II, edited by Helen M. Robinson. Chicago, Ill., University of Chicago Press, 1953, pp. 31-63.
8. Sabatini, Raoul W., Abnormal vision and learning difficulty, Optom. Weekly, 43 (29): 1165-1169, 1952.
9. Walton, Howard N., Visual and reading improvement in industry, Am. J. Optom. and Arch. Am. Acad. Optom., 32 (11): 563-578, 1955.

NIGHT DRIVING SEEING PROBLEMS*

Oscar W. Richards†
American Optical Company, Research Center
Southbridge, Massachusetts

Most traffic accidents occur at night. Analyses of accident statistics have failed to relate them to faulty vision, yet driving is largely a reaction to visually obtained information. From the biological viewpoint, humans driving at night are working at a task for which they are poorly equipped. Nocturnal animals have specialized eyes for seeing with little light and they do not compete in daylight. While our eyes can adapt to a large range of light, they see less well as darkness comes and have no specialization for after dark life. A brief look at our night vision problems shows a considerable loss in seeing that may explain the nearly doubled night traffic accident rates.

At dusk seeing becomes difficult. The sky is still quite bright while objects on the road seem to merge with their shadows and fade in the darkness. The overhead brightness veils the field of view with glare that prevents the retina from adapting enough to use efficiently the small amount of light reflected from the roadways. Parking, or low beam lights aid in placing vehicles, but high beams add to the veiling glare and should not be used. Clues to stimulate the two eyes into fused binocular vision, become fewer with deeper twilight and more strain is placed on the muscular coordinating mechanism of the eyes. It is important to have the best possible correction for any phorias or muscular deficiencies of the motorist's eyes. The glare and smaller amount of visual information, handicaps judgment of depth, and of position and speed of vehicles. At twilight objects seem to be farther away than their actual distances.[37] With greater darkness, changes appear more rapid and momentary, and a second look for rechecking becomes less and less possible.

With darkness the broad fields of view of daylight close in to the region illuminated by the headlights, the overhead glare vanishes, and the eyes adapt to the prevailing light level of the headlights. Unless there is moonlight, or other lights, no more can be seen than that lighted by the headlights of the cars on the road. The presence of other cars

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 7, 1957. For publication in the November, 1958, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Ph.D. Research Supervisor for Biology.

may either help or hinder vision and heavy traffic can lessen the road illumination by a fourth. In urban regions the greater lighting provides larger fields of view with unequal, concentrated and distracting information which varies randomly, moment to moment.[37]

The night driving fields of view are smaller, the visual content of the field changes rapidly and the information received is more concentrated. Values change, colors fade, resolution decreases, pattern predominates, even when it is poorly defined, and large objects must be recognized from a patch or smear of light or shadow. No information is obtained from subliminal fields which appear as blind areas in the somatic field. Close objects are seen directly by the light they reflect, but, depending on the available light and their reflectance, when they are from 25 feet to a half block away they can be seen only in silhouette against the slightly brighter surround. A large area like the back of a truck may be seen before a small, dirty, although slightly brighter, tail light is visible. Transition zones at tunnels or ends of brightly lighted streets are dangerous unless so lighted as to ease the adaptation of the eyes.

Seeing becomes less possible away from the main beam of the headlights: the eyes tend to search for a more sensitive part of the retina to help interpret the blurred images and the world appears unreal and ghostly. As Blackwell has aptly said, night presents a new geometry. The searching movements and the adjustments of the pupil increase fatigue.[22] Some drivers tend to stare fixedly which can lead to fatigue, and fascination which can paralyze a normal response to a dangerous situation. Others may be so distracted in the rapidly changing scene that they cannot drive properly without a marked reduction of speed. Again, on the lonely country road there may not be enough stimulation to keep a tired driver awake. Truck drivers who have slept all day may survive, while a tired motorist having worked all day may not survive, or even worse, may injure others from failure to keep in his lane.

In daylight the driver is told to watch the big picture, two blocks ahead, or a half mile ahead in the country, but at night there is no large picture and it is risky to look afield. The small fields, reduced still more by speed, may lead to overconfident driving from failure to see enough.

How big is the field of view? Weston[37] considers it to be $5° \times 8°$, Figure 1. The figure shows the field, rectangle A, at 1200 feet, based on Nagel's pictures[30] of the experimental illumination on the 72 feet wide Connecticut Turnpike.

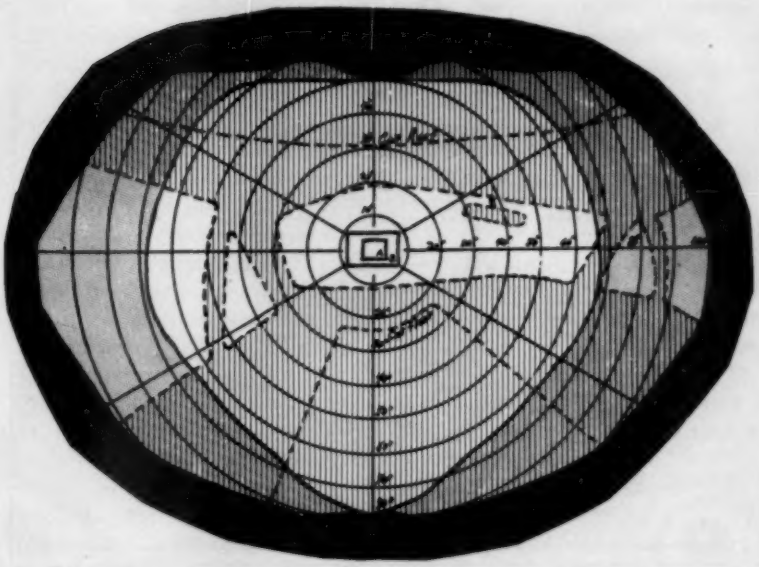


Fig. 1. Comparative fields of view seen by a motorist. The binocular field is not stippled. Regions blocked out by the auto are marked with vertical lines. A. is the field of a 72 foot road at 1200 feet and B. is Weston's 5 × 8 degree night driving visual field.

Lower cars restrict overhead vision and window patterns further limit the view. A forward field of 30° probably covers most driving. The common binocular field averages 60° and spectacles provide fields of view from 40° to 60°. The macula of the retina subtends about 9°. A wide side vision may be less important at night as little can be seen at the edge of the field and additional clues are provided by the lights of cars approaching on sharply angled side roads.[4] Visual efficiency falls off rapidly away from the central fovea.

Measurements of road luminances made six years ago indicated that 4 ft-L is about the brightest and that little useful information was obtained from less than 0.003 ft-L at the edges of the road.[32] Recent data have fallen within these limits. Figure 2. The luminance along the center line of the new Hudson Road is reported within 2.3 to 0.4 ft-L and from 0.12 to 0.04 ft-L at 100 feet from the luminaries. The experimental lighting on the Connecticut Turnpike appears not to provide more than 1 ft-L. The IES Handbook[24] data indicated bright-

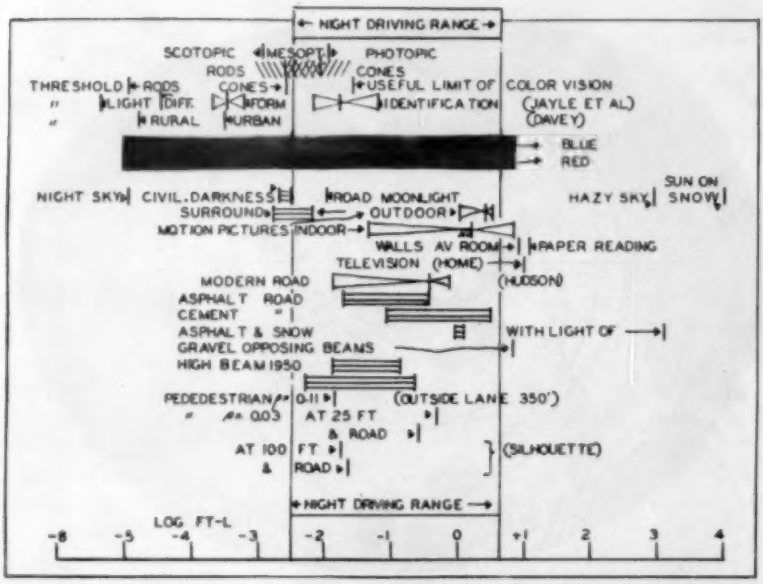


Fig. 2. Luminances of night driving and some information on vision at the indicated levels.

nesses of 0.018 to 0.35 ft-L for asphalt and 0.4 to 3 ft-L for concrete roads, depending upon the illumination and the condition of the roads. Drive-in screen luminances are reported to average about 0.4 ft-L with surrounds (when unlighted) of 0.003 ft-L. A pedestrian with a gray suit reflecting 11%, 350 feet away has a luminance of 0.012 ft-L and another with a brown suit reflecting 3% measured 0.016 ft-L at 100 feet ahead.[32] The pedestrian was less bright than the road and seen only in silhouette. (In this example, Figure 2, the pedestrian was brighter than the road when 25 feet ahead but darker than the road beyond about 50 feet ahead.) These values show that the eye uses low photopic and upper mesopic vision at civilian night driving levels and we may examine its efficiency under these conditions. Scotopic vision is *not* concerned at these luminances. Davey[5] reports dark adapation levels of log $\overline{5}.79$ ft-L on a dark road of 0.7 to 0.2 ft-L, log $\overline{4}.47$ in the strand region of London and of log $\overline{5}.17$ ft-L in the country. Some five minutes would be required for the eyes to adapt from bright city levels to those in the country.

The rate and extent of dark adaptation depends upon the level at

the beginning of the adaptation as well as the luminance concerned and the physiological state of the organism. Daytime exposures to intense sunlight raise the threshold at night, but this seems more important at lower luminances than those of civilian night driving. Nutritional deficiencies (especially vitamin A) from prolonged malnutrition, or a transient result of diarrhoea, etc., and diseases (endocrine, nervous system, uncontrolled diabetes, psychoses,[10] etc.) decrease the ability to adapt to lower luminances. Dark adaptation is reported slower at age ranges of 20-29 and 50-59, than at 30-50 and over 60.[27] Individual differences and variation amount to 0.2 to 0.3 log unit. Investigations by Weale and others indicate that nervous mechanisms may be involved in dark adaptation as well as chemical changes in the retina. Oxygen is about the only efficient stimulant to the dark adaptation process. Since low adapatation levels are not involved, tests for motorists need only measure the first ten minutes of dark adaptation. So far adequate, simple screening tests have not been developed and testing dark adaptation is mainly a laboratory procedure.

Night vision depends on more than dark adaptation although marked reduction in the ability to adapt could prevent safe driving. People with adequate ability should wait a few minutes when changing from a brightly illuminated room to a dark unlighted road, and those with less good adapatation should wait longer before driving. How to use the retina, muscular coordination, and focusing ability of the eye are important in night vision. Proper motivation and alertness are essential.

Graded transition lighting is necessary at tunnels, underpasses, and other regions where the luminances change more rapidly than the driver can adapt to the changes. Otherwise the strain on the driver, uncertainty, slowed responses are potential means for accidents. Proper gradations in lighting for daytime will usually not be the best for night driving. The knowledge and limitations of normal and deficient vision should be utilized when building and operating roadways.

The transition from cone to rod vision is gradual and color vision is lost at about 0.04 ft-L, Figure 2. At the lower driving levels reds become darker and blues brighter, but color cannot be expected to aid the motorist to see obstacles for other than the brighter road lighting. Traffic lights are usually bright enough to be seen when properly positioned against an adequate surround. Traffic engineers should be held responsible and given authority so that traffic signals are visible at night and not lost among colored advertising and other distracting lights. Color coded highway signs may be of little use and possibly even hazardous on dark rainy nights, unless they are made sufficiently large

or properly reflectorized to be visible under adverse conditions.

Colored glass before the eyes reduces vision at night by about the same amount as the light absorption of the glass and should never be used for night driving.[32] Perceptual distance is shortened at lower luminances. At night, seeing and stopping distances become about the same at some speed (sometimes under 50 mph). At this point the loss of even a very little light from any absorbing glass may result in a rear end collision.

With average daylight small objects do not need to have high reflectivity or to contrast greatly with their surround to be seen and recognized. This upper limit for driving luminance is also about the

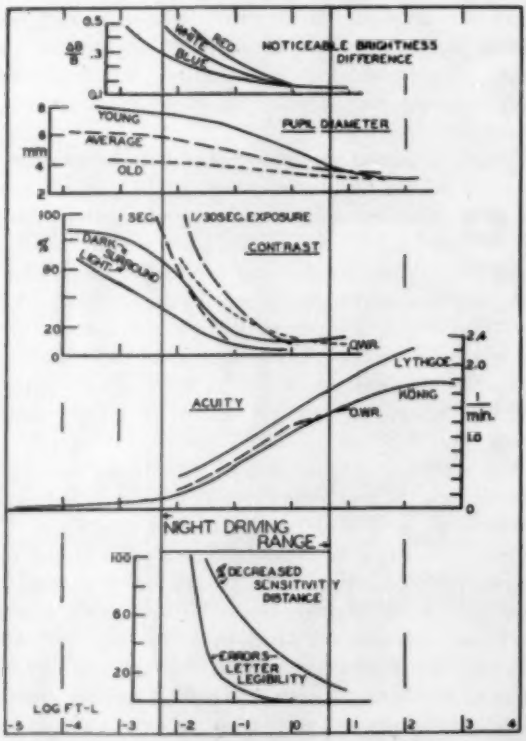


Fig. 3. Some aspects of human vision with decreased illumination. (From various sources[32]: fractional exposure contrast from Blackwell[3]; distance sensitivity from Hirsch & Weymouth, 1954. Am. J. Optom. 31:276; letter legibility from Fransworth, 1952, Med. Res. Lab., New Lond., Conn. Rept. 209.)

same brightness at which people tend to turn on electric lights. Vision as expressed by standard observer curves at 0.01 ft-L is about 73% of what it is at 1 ft-L. Some of the changes in vision with less light are summarized in Figure 3.

On the highway, objects reflecting little light to the eye must contrast with the background, as contrast becomes more important after dark than acuity. Unless the difference in luminance between the pedestrian and the road is great enough for that level, the pedestrian will not be seen and when only slightly more visible he may not be seen within the seeing or stopping distance available to the motorist for the speed of driving. Actual measurements and common experience show that pedestrians in dark clothing are scarcely visible on the roads even when night seeing is optimal, and their visibility should be considered in the establishment of proper night speed limits for a given road.

Some years ago Luckiesh and Moss measured 150 people, found normal vision (20/20) at 10 ft-L, and a decrease in the average vision to 20/55 after adaptation to 0.01 ft-L. The person with the best vision at the lower level had only half of the acuity available at the higher level. This is less than the minimum for daylight driving in some states! Other measurements indicate that to obtain the same acuity at the lower level a sign must have letters five times larger. Contrast must also increase six to twenty times to keep the same size sign legible at the lower brightness. This assumes, of course, sufficient time to see. In other words, for a given contrast there is a minimal size that can be seen.

Seeing is limited by speed. Unless a minimum of light is focused on the retina for sufficient time there is no vision, and when the image moves faster than the eye can compensate, vision is impossible. For black and white seeing 1/30 second is said to be adequate, while 1/5 second is necessary for seeing color. Fast driving changes the blurring so that smaller fields at greater distances in front of the driver remain clear. Danielson[3] reports that driving at rapid speeds is more comfortable when only the central field is clearly seen and the eyes shielded from the blurring of side vision. The loss of clues from the blurring at the side may lead to over-confidence and even greater speed. Roper found seeing distances to decrease by 20 feet for each increase of 10 mph. Vibration above 2-5 cps decreases vision[8] and the loss of vision at high driving speed increases from the greater vibration of the vehicle. At high speeds the estimation of movement and judgment of speed may be halved. The safe speed for a given driver is that wherein the perceptual load is not too great for proper response. At night this load is greater and speeds should be proportionately less. A driver with poor

night vision may have to go so slow as to be a hazard on an express turnpike.

Seeing involves dynamic factors not found in a camera and blurred photographs taken from a motor vehicle should not be used to explain human vision since the camera blur can be made good or bad, by controlling the lens quality, focus, aim, shutter speed and film sensitivity.

The eye is a viscous liquid system maintained at a nearly constant pressure and volume by interchange of nutrients and wastes with the circulatory system. It floats in the orbit against fat pads and muscles control its orientation, light input and focus. Muscles usually work against each other with graduations of shortening obtained by the use of fewer or more individual fibers within the muscle bundle. On a fine scale, the movement is oscillatory and the equilibria are dynamic.[1, 2] This may be necessary, as the retina which translates the incoming light energy into nerve impulses, is a mosaic of rods, cones and connective tissues and holding the light image on the same retinal units leads to fading and invisibility. The small tremor movements utilize fresh receptors of adjacent regions making continuous vision possible. Other muscular movements correct these drifts and keep the view in the sensitive fovea. The oscillations of the focusing muscles aid the eye to the best adjustment as we look from one distance to another. The movements of the iris are stepwise and close observation will show also the volume changes from the pulse. The mechanisms are controlled by the nervous system and seeing efficiency depends on the response to changes from moment to moment in the amount and distribution of the light entering the eye. At night the changes in illumination can occur faster than the eye muscles can adjust the eye to the changes. The resulting conflict in the seeing mechanism and the strain of trying to get a clear and sharp view, which cannot be obtained under these conditions, is a source of strain, frustration and fatigue in the driver.

A sharp retinal image is perceived quicker and is less disturbed by glare light. A properly placed quarter diopter cylinder has been reported to improve night acuity by 25%.[12] Eyes looking into a monotonous field devoid of fixation objects tends to a focal position around 1 meter (empty field myopia). With less stimulating light at night a myopia may develop that can be explained partly by the increased spherical aberration accompanying the larger pupil and partly from the Purkinje shift, which is a gradual change from detailed cone mediated vision, to the pattern vision at low intensity from the rods. The change begins within the luminances of civilian night driving, but the driver's eye does not reach scotopic levels when nothing can be seen at the rod

free fovea (physiological central scotoma).

Not all people show a night myopia at driving levels and I have found an occasional person who sees better at these levels with a small plus rather than minus add. A low grade hypermetropia may become essentially emmetropia as a result of the night myopia, but a myopia is worsened, especially when handicapped by inadequate undercorrection. At night driving levels some people can see better with —0.50 to —1.50 diopters additional correction, but tests have shown that there is no universal prescription and that too many would see less well to justify any such procedure. While a hypermetrope may see better without his spectacles when his far-sightedness and night myopia are about the same, this should be permitted only when the spectacle correction is free from cylinders or prisms.

Another problem is aniseikonia where unequal imagery, when not corrected, provides a distorted world that disturbs driving. With good lighting and familiar objects these distortions are less important, but unfamiliarity or freedom from known clues (as in the leaf room) brings them out. Likewise, aniseikonia disturbs night driving more than daylight driving because of the lack of clues and the unfamiliar appearance of objects. Little is known as to the extent of these effects and screening for aniseikonia would be worthwhile, since this anomaly can be a problem in auto driving. A change in prescription may lead to an accident, as the case reported by Morrision[29] where the patient said the spectacles were comfortable but it was difficult for him to keep in the right part of the road, a trouble attributed to aniseikonia.

Morrison[29] also recommends that persons do not drive for some time after receiving their first spectacles. Newly corrected myopes tend to brake too quickly, while hypermetropes brake too slowly, both of which are unsafe. When a change of prescription is likely to require some getting used to, it should be the obligation of the optometrist to warn the patient and aid him to understand the process. Driving, or night driving, may be contra-indicated for a time.

The loss of an eye requires compensatory care while driving, but driving does not seem to be unduly hazardous when the remaining vision is good.[19]

Color vision plays only a small role at night. Traffic lights are bright enough to be differentiated; likewise reflectorized signs, but colors should not be expected to assist driving. At the lower levels of road illumination colors are seen as grays varying only in brightness.

High acuity is unnecessary for daytime driving when the pupils are small. There are reports of accident-free driving with low acuity,

even 20/400, with no great difficulty after the first five minute adjustment. At night this is no longer true: the weak blurred images do not have enough contrast for seeing and the driver may not see obstacles. Motorists with less than 20/20 daylight vision should drive more slowly at night than those with better vision, and the proportionate decrease in speed should be determined for a representative section of the driving public.

Aging decreases vision along with the other changes of senility. More light is necessary for seeing with the smaller pupils and failing system. One study indicates that for equal seeing the light needs to be doubled for every thirteen years of age.[11] Figure 4 summarizes other

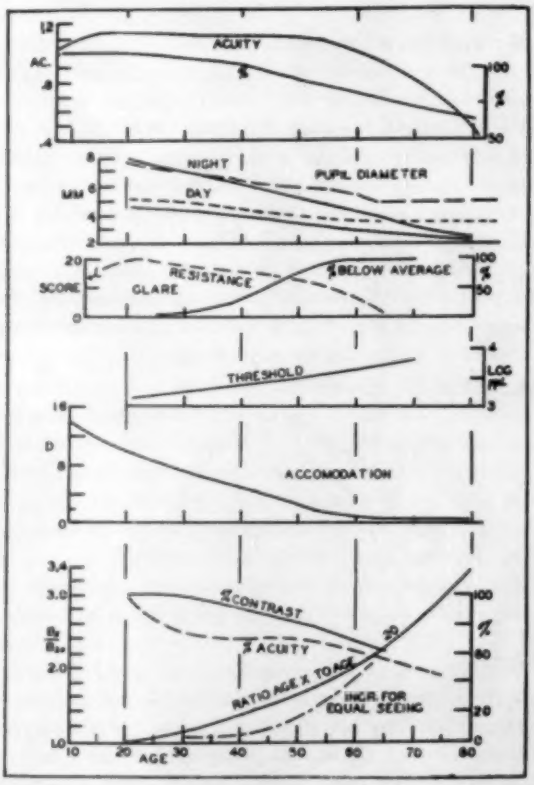


Fig. 4. Some age changes in human vision. (From various sources[82]; bottom curve from Guth.[11])

information showing how vision decreases with age. Acuity and contrast sensitivity decrease and the decreases may result in lower levels than are legal for driving in some states. This is another reason for a reconsideration of the importance of Snellen acuity as a criterion for a driving license. Since the available luminance is scarcely adequate for the best eyes, many older people should drive less rapidly and essential signs and signals should be much larger and brighter than those required for the best young eyes. Fortunately, older people generally become more conservative and drive more carefully. The professional responsibility of the ophthalmologist and optometrist is more important with the older patient, who needs spectacles that help as much as possible and perhaps also advise on when not to drive at night. Opacities forming in the eye reduce vision to an unsafe leevl. The vision specialists have the problem of determining what is an unsafe level and advising the traffic engineers and the lawmakers so that better highways can be made and safely operated.

Fatigue increases when seeing involves intense effort. More muscles are involved with difficult seeing, such as those of the brow and even cheek and lip muscles. When these changes lead to general body tension, beyond an alert relaxedness, still more fatigue can build up. Weston[41] states: "Conditions of lighting which are suboptional for particular visual tasks accelerate the onset of fatigue occasioned by seeing, chiefly because they necessitate undue muscular exertion in getting the required visual information, but also because they necessitate undue mental 'exertion' for the processes of interpretation and discrimination." The fatigued driver needs greater stimulation for proper response. Since such increase is not possible with the very small illumination (as compared with daylight), the fatigue increases and seeing becomes worse. In cities, or at some intersections, the large numbers of lights may overstimulate the tired driver and the lone traffic signal may not be perceived, while on lonely country roads there may not be stimuli enough to keep a tired driver awake.

Seeing at night may be worsened or even eliminated by adverse weather, dust storms, heavy rain, or dense fog. The field of view is impoverished, objects are less visible and vision is distorted by the streaky, dark surfaces that tend to camouflage silhouette seeing. Improvements in illumination promise some help, but the eyes cannot function without light and we have to make the best of a poor situation.

Glare from oncoming headlights can reduce night driving vision, especially when rapidly repeated from a succession of cars on a narrow curving road. The effects and mechanism are well known: a general

veiling and reduced contrast. I have seen no so-called night driving glasses which solve the problem. The most successful aids are screens which block out only the glare sources, but do not steal light from the rest of the field of view. A red segment in the upper left can be used to decrease glare by tilting the head slightly so that the oncoming lights are in the segment, because red light does not spoil the dark adaptation, and limiting the red to a segment leaves the rest of the road in unobscured view. Holding the hand over one eye or even shutting one eye will protect that eye from the glare. As soon as the car passes the protected eye is used and the other one closed until the after-images subside. The discomfort from intense glare may be due to the irregular behavior of the iris trying to respond to areas of the retina calling for more light and others calling for cutting down the glare light. The adverse effect of glare depends on the amount and location on the retina. Hopkinson attributes the complaints of myopes on glare sensitivity to the dazzle from the flashing of the edges of the thick lenses, a difficulty not found with plus lenses.[23] Lighting or making spectacle frames luminous, and other devices to raise the retinal adaptation level must and do fail to help the motorist, because the resulting glare reduces vision and the higher adaptation level may be too great for him to see the roadway details.

The illumination engineers treat glare as an overall veiling brightness and Boynton[19] has demonstrated this glare experimentally. Other investigators find the affect of glare to depend also on the nature of the visual task. My own experience shows the annoyance from glare to depend more on having the proper correction so that the lights are imaged most sharply on the retina. This can be done for me with a 20/15 day correction or a proper minus fitover for a less good daytime correction. I urge correcting myopes fully, unless there is a specific reason for not doing so.

The motorist who must wear spectacles is handicapped when compared with the driver not needing such aids. Unless the surfaces are coated some 8% of the light is lost from surface reflections. Should this light reach the eye it is a source of annoyance as veiling glare or even a dangerous distraction when the reflections are nearly in focus.[40] Such reflections show better at night. I remember wearing a pair of cemented doublets for aniseikonia that made safe driving on a street, with cluster lights at each side, almost impossible until the inside surfaces were coated to eliminate the reflections. Therefore, optometrists should use extra care in prescribing and fitting spectacles for those who drive. Not only should motorists be given the best vision possible but the most comfort-

able spectacles, free from reflections, properly tilted and with the segments placed so that interference is least. When such a pair cannot also meet occupational requirements and the patient does considerable driving, another pair is needed. Those concerned with operating our roads are concerned with driver comfort, because the irritated driver is a potential source of accidents. Ill-fitting spectacles may upset a driver and having to tilt the head unduly to see the road above a trifocal segment can be enough annoyance to become the disturbance that triggers an accident.

There seems to be no point in discussing whether or not vision is a contributory cause of accidents—no one drives long with his eyes shut. If we knew enough about motorists' seeing ability at night, the excess number of night accidents would be largely explained. The decreased seeing at night and reasons for it summarized in this paper are general. The individual driver may be much better or worse than the average and is entitled to the judgment of his peers: here the responsibility falls on the vision specialist.

The recent training and rules proposed for better daytime seeing and driving suggest that proper training for night seeing should help. The following rules are offered as a beginning:

1. Take enough time to get used to seeing (adaptation) when leaving a bright place before starting to drive at night. Drive slower during transitions from bright lighting to little or no lighting.
2. Relax the eye muscles by looking about as much as safe driving permits. Never stare for long at the same region.
3. Protect the eyes from glare. Look to the side of the road rather than at a glare source. Insist on dimming high or bright lights.
4. At night never wear sunglasses, or tinted spectacles, that have absorption over the entire field of view. Absorption in a small region at the left or upper left may be useful, but the road in front of the driver must always be clear.
5. Keep spectacles, windshields and lights clean and free from surface damage that reduces their transmission.
6. Slow down until the perceptual load is not too great for good, safe driving.

Optometrists and other vision specialists must consider night driving problems and deficiencies so that they can provide the professional care for the best possible seeing. This will ultimately bring forth other criteria than static acuity and may even lead to specialized examining

methods to evaluate vision when the lighting cannot be quite enough. From the vision viewpoint we must insist on improved road and car lighting, more readable signs and signals, and other aids to relieve the extra load on night seeing. Driving includes much more than seeing and other experts must cooperate with the vision specialists toward making better use of the information gathered by the eyes of the driver and for better vehicles and roadways.

REFERENCES

1. Arnulf, Albert, Odette Dupuy, and Françoise Flamant. Méthode objective pour l'étude des défauts du système optique de l'oeil. Communication aux Réunions sur les problèmes de l'optique contemporaine, Florence, Sept., 1954, pp. 330-335.
2. Arnulf, Albert, Odette Dupuy, and Françoise Flamant. Les microfluctuations d'accommodation de l'oeil. Annales d'Optique Oculaire, 3 (5): 109-118, 1955.
3. Blackwell, H. R. and D. W. McCready. Foveal Contrast for Various Durations of Single Flash (Unpublished Data). Personal Communication, 1957.
4. Danielson, R. W., The relationship of fields of vision to safety in driving. Trans. Am. Ophth. Soc., 54: 369-416, 1956.
5. Davey, J. B. and Michael Sheridan. Levels of dark adaptation when driving at night. Brit. J. Physiol. Optics, 14 (3): 183-189, 1957.
6. Davey, J. B., Visual acuity and driving ability. Optician, 134 (3466): 204, 1957.
7. Davey, J. B., The effect of visual acuity on driving ability. Brit. J. Physiol. Optics, 13 (2): 62-78, 1956.
8. Ercoles, Anna Maria, Adriana Fiorentini, and G. Toraldo di Francia. Visual experiments with a vibrating test object. Optica Acta, 3 (1): 40-46, 1956.
9. Finch, D. M., Some factors influencing the night-visibility of roadway obstacles: Preprint No. 27 of the 1956 Conference Papers of the Illuminating Engineering Society. Abstract, Illuminating Engineering, 51 (9): 619, 1956.
10. Granger, G. W., Night vision and psychiatric disorders: a review of experimental studies. J. Mental Science, 103 (430): 48-79, 1957.
11. Guth, Sylvester K., Effects of age on visibility. Am. J. Optom. and Arch. Am. Acad. Optom., 34 (9): 463-477, 1957.
12. Hamburger, F. A., Das Sehen in der Dämmerung. Vienna, Springer-Verlag, 1949.
13. Tufts College. Institute for Applied Experimental Psychology. Handbook of Human Engineering Data. 2d ed., Part 3, Vision. Medford, Mass., Tufts College, 1951.
14. Highway Research Board. Studies in Night Visibility. Washington, D. C., 1951. Bull. 43.
15. Highway Research Board. Road-user Characteristics. Washington, D. C., 1950. Bull. 66.
16. Highway Research Board. Effect of Tinted Windshields and Vehicle Headlighting on Night Visibility. Washington, D. C., 1953. Bull. 68.
17. Highway Research Board. Night Visibility. Washington, D. C., 1954. Bull. 89.
18. Highway Research Board. Night Visibility. Washington, D. C., 1955. Bull. 127.
19. Highway Research Board. Night Visibility. Washington, D. C., 1956. Bull. 146.
20. Highway Research Board. Driver Characteristics. Washington, D. C., 1957. Bull. 152.
21. Highway Research Board. Night Visibility. Washington, D. C., 1957. Bull. 163.
22. Hopkinson, R. G., Glare discomfort and pupil diameter. J. Opt. Soc. Am., 46 (8): 649-656, 1956.
23. Hopkinson, R. G. Personal communication.
24. Illuminating Engineering Society, IES Lighting Handbook, 2d ed. New York, N. Y., 1952, pp. 2-1 to 2-41, 13-1 to 13-14.
25. Jayle, Gaetan E. and Albert G. Ourgard. La Vision Nocturne et ses Troubles. Paris, Masson et Cie, 1950.

26. Jayle, G. E., R. Camo, R. Boyer, and J. Ansaldi Principes et résults de l'exploration cinématographique de la vision nocturne. Bull. Société Française d'Ophthalmologie. 67: 508-522. 1954.
27. McFarland, R. A. and M. B. Fisher. Alterations of dark adaptation as a function of age. J. Gerontology. 10: 424-428. 1955.
28. Morrison, L. C., Visual perception and the driver (letter to the Editor). Optician. 130 (3371): 433-434. 1955.
29. Morrison, L. C., Certain aspects of visual space perception as related to the vehicle driver. Optician. 129 (3345): 421-423; (3346): 451-455. 1955.
30. Nagel, George A., A highway lighting test installation. Illuminating Engineering. 52 (3): 155-165. 1957.
31. Pirenne, M. H., F. H. C. Marriott, and E. F. O'Doherty. Individual Differences in Night-Vision Efficiency. London. H. M. Stationery Office. 1957. Medical Research Council. Special Report Series. No. 294.
32. Richards, Oscar W., Vision at levels of night road illumination. in Night Visibility. Bull. 56. Highway Research Board. Washington. D. C., Highway Research Board. 1952. pp. 36-65.
33. Richards, Oscar W., Yellow glasses fail to improve seeing at night-driving illuminances. Highway Research Abstracts. 23 (7): 32-36. 1953.
34. Richards, Oscar W., Vision at levels of night road illumination. II. Literature 1952-1956. in Night Visibility. Bull. 146. Highway Research Board. Washington. D. C., Highway Research Board. 1957. pp. 58-66.
35. Richards, Oscar W., Vision at levels of night road illumination. III. Literature for 1956-1957. In Press.
36. Spector, W. S., editor. Handbook of Biological Data. Philadelphia, Pa., W. B. Saunders Co., 1956. pp. 316-321.
37. Sachsenweger, Rudolf. Stereoscopic acuity in twilight. Optician. 131 (3399): 475-481. 1956. Condensed from Archiv für Ophthalmologie. 155: 496-517. 1954.
38. Savin, L. H. and H. C. Weston. Discussion on the visual problems of night driving. Proc. Royal Soc. Med., 50 (3): 173-179. 1957.
39. Grime, G., Road illumination by headlamps or street lamps. Proc. Royal Soc. Med., 50 (3): 179-184. 1957.
40. Stimson, R. L., Lenses for aphakics. Brit. J. Physiol. Optics. 14 (2): 78-89. 1957.
41. Weston, H. C., Visual fatigue with reference to lighting. in Symposium on Fatigue. edited by W. F. Lloyd and T. W. Welford. London. H. K. Lewis & Co., 1953. pp. 117-135.

ANNOUNCEMENT

ALUMNI MEETING AT SOUTHERN COLLEGE OF OPTOMETRY

Dr. B. B. Parks, Greenville, South Carolina, president of the Alumni Association of the Southern College of Optometry, has issued a call for all Southern College of Optometry graduates and their wives to attend an alumni reunion on the college campus, 1246 Union Avenue, Memphis, Tennessee, December 13-15, 1958. A dance will be held Saturday night with association meetings on Sunday and Monday.

A METHOD OF FITTING CONTACT LENSES AND CORRECTING APHAKIA*

A. Harry Malin†
San Diego, California

In the past five years the correction of aphakia has been greatly modified, for now many optometrists and ophthalmologists are using corneal lenses for this purpose. The corneal lens is of singular benefit in view of certain optical and mechanical characteristics, especially in the case of uniocular aphakia. A spectacle lens correction produces up to 30% overall aniseikonia, which makes fusion practically impossible. With spectacle lenses correcting monocular aphakia, fixation away from the primary position results in great prismatic imbalance, making co-ordinated movements most difficult. Only with the introduction of the corneal lens have the uniocular aphakic patients been able to be helped to efficient binocular vision. To be sure, there is a residual aniseikonic error (average, 10%) with the use of the corneal lens. Nevertheless, patients seem to be able to fuse with first, second, and even third degree fusion with these lenses. Rosenbloom[1] measured the aniseikonic error and stereopsis of eight patients. It is interesting to note that his is the first article in the AMERICAN JOURNAL OF OPTOMETRY (1953) wherein the attributes of good single simultaneous binocular vision for monocular aphakic patients is discussed. In the literature preceding Rosenbloom's article (1952), Berens, Girard, and Foree[2] discuss the average wearing time of the aphakic patients. Training techniques are not mentioned. There are observations on the type of error which is corrected and some aspects of binocular vision.

Another optical benefit accruing from the use of corneal lenses is the expanded visual field of the corrected eye. The visual fields of one of the patients mentioned in the Berens *et al* article are plotted (1) prior to the onset of cataract, (2) post-operatively with the cataract spectacle correction, and then (3) finally with the corneal lens. The targets used were 1/1000 and 3/1000. The field study with the spectacle lens as compared to the corneal lens exhibits doubling the size of the visual field by the corneal lens. We are familiar with the mechanical disadvantages of the correction of aphakia with spectacle lenses. They are not only heavy, but the lenses are unsightly and very difficult to keep in

*Submitted on December 29, 1957, for publication in the November, 1958, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist. Fellow, American Academy of Optometry.

proper adjustment so that the patient has optimum vision at all times.

In the BRITISH JOURNAL OF OPHTHALMOLOGY as early as 1950, A. Hirtenstein[3] described the correction of sixteen patients successfully and two patients unsuccessfully. However, he, too, discusses the average and maximum daily wearing time. In 1957, Goar[4], advocated the use of the contact lens in uniocular and binocular aphakia. He lists the results of sixty-three patients and he is most encouraging in his analysis of the use of these lenses.

Corneal lenses are fitted from five weeks to six months after surgery, depending on the surgeon's preference. Moderate senile debility is not a significant factor, two patients of the author, aged 78, having been fitted successfully.

Briefly, the general fitting technique will be considered. It is as follows: On the initial visit, the keratometer finding is taken. The lesser diopter reading is recorded and the lens will be subsequently fitted according to the flatter curved meridian of an astigmatic cornea.

In ordering the first training lenses, this finding is modified by the constant error of each particular operator. That is, with experience, the increment (usually) becomes known so that there will be fewer training lenses required. Certain anatomic features should be noted, principally the tonicity of the palpebra. If they are flaccid there will be little subjective reaction to the lens in the early training. Ideally the fissure is large and the cornea small and centrally placed. The alphakic eye usually has reduced corneal sensitivity, probably as a result of the semi-circular incision at the limbus. In senility, there seems to be reduced metabolic requirements so that the lens produces less epithelial disturbance and the lids are usually flaccid.

The second visit is concerned with patient training in the placing and removal of the lens. This is accomplished under very close supervision. Deviations are not permitted from the standard technique. The lens is wetted and prepared with the fingers of the right hand and placed on the tip of the right index finger. The thumb and index finger of the left hand steady the eyelid. The patient is instructed to look at the lens at all times.

Blinking must be preceded by the careful lowering of the lens-carrying finger. Once the right index finger has completed its movement and the lens is placed within the palpebral fissure, the finger must be lowered, then the lower lid is released by the thumb, and the upper lid finally released. This must be a slow and deliberate coordinated action.

Immediately upon placing the lens, the patient is instructed to raise his chin and direct fixation downward. When initial tearing and

discomfort subside, a schedule of exercises is begun so that the patient participates actively in the conditioning of the eyelids. The lens stimulates the eyelids, the upper one especially. Gradually the response becomes a faint sense of awareness. The patient is now instructed in the method of recentering the lens on the cornea after the examiner displaces it under the lower and then the upper lid. This is an easy technique to demonstrate, especially by one who continually wears the lenses himself. Senile patients exhibit little reaction to these procedures.

When these skills have been accomplished, the patient is given one lens to use at home for training purposes. Also he is given Instruction #1 as follows:

INSTRUCTION NO. 1

Beginning today, you are to practice with your training lens for frequent one-half hour periods: at least three times per day. Insert the lens as skillfully as you know how, do the exercises, then remove it and repeat this process with the other eye. Continue this practice for the full half-hour. Your purpose is to develop ability and control in placing your training lens, exercising and removing it.

EXERCISES

Note: You must do your exercises slowly. If you need to blink, first look down, then you may do so.

1. Following a pencil, look up without blinking: maintain the position for a moment and following the pencil, look to the left and look to the right. Then, lower the pencil and blink your eyes.
2. Open the lids very wide, and while looking straight ahead, permit the lids to close very slowly
3. Open the lids very wide: look straight ahead: now look at the top of the pencil and move it in a clockwise circle, then in a counter-clockwise circle.

On the third visit certain accomplishments of the patient must be demonstrated. Placement and removal must be deliberate. Exercises must be performed with some degree of ease. If the above is not accomplished, then the first series of instructions is continued and the use at home of only one lens is permitted.

When the examiner judges that the exercises, placement, and removal are satisfactory, the lenses are evaluated and the patient advances to Instruction #2 and is given two lenses for training purposes at home.

INSTRUCTION NO. 2

Today you are to use your lenses for frequent half-hour periods (a minimum of three times per day). During the first ten minutes of the half-hour you are to allow any tearing or blinking to subside, then in the last twenty minutes you are to perform the following exercises:

EXERCISES:

Note: It is important to do the exercises slowly. If you need to blink, first look down, then you may do so.

1. Following a pencil, look up without blinking: maintain the position for a moment and following the pencil, look to the left and then to the right. Lower the pencil and blink your eyes.
2. Open the lids very wide and while looking straight ahead, permit the lids to close very slowly.
3. Open the lids very wide: look straight ahead: now look at the top of the pencil and move it in a clockwise circle, then in a counter-clockwise circle.

In three days you are to use your lenses for frequent one-hour periods (a minimum

of three times per day). However, you may use them as often as you wish, provided the lenses are removed and not worn for fifteen minutes in-between the one hour periods. Also, you are to perform the exercises for three, three-minute periods for every hour of use.

The last step in preparing the lenses for use: Apply wetting fluid, do not wash with water. Use your mirror occasionally to make sure your lenses rest gently on or below your lower lids.

The evaluation is in three parts:[3] (1) The diameter of the lens must be small enough so that it does not touch both lids when the eye is in its primary position. The lens must be smaller than the apparent diameter of the iris. When the lids blink, it must be small enough so that the upper lid moves it superiorly. From the viewpoint of a minimum metabolic disturbance, the lens cannot be too small. Largeness can disturb corneal metabolism. Later it will become evident that visual considerations limit the smallness of the lens. Also excessive lid irritation will result from the use of lenses that are too small.

(2) The inside radius of curvature must be short enough so that bubbles do not form under the lens and the lens does not leave the cornea or fall from the palpebral fissure when the eye fixates in the four cardinal positions. It is too loose if the above occur. In the inferior fixation position, and with the upper lid slightly retracted, the circumcorneal vessels are not to be blanched by the superior edge of the lens. If they are, the lens is too tight and the inside radius must be increased.

(3) The configuration of the tear layer between the cornea and the lens is of utmost importance. To determine it, 1% fluorescein is instilled with an applicator on the sclera above the cornea, and the dye is studied in a blue light (not necessarily an ultraviolet light source). With the eye in the primary position, the lens is gently positioned on the cornea by manipulation of the subject's eyelids. Between the apical area of the cornea and the lens there should be very little dye and hence this area will appear as a dark round or oval area. Essentially spherical corneas exhibit a circular nonfluorescence, and astigmatic corneas, an oval.

The lens cannot rest on a single round or oval contact. It must also be gently balanced on a sector of its circumference. Generally speaking, a maximum of ¼ the circumference is considered suitable. It can hardly rest on less and should not be in contact with the cornea on more than the ¼. In the correction of aphakia, the radius of curvature may be reduced so that up to ½ of the circumference may touch the cornea. This will cause a weaker minus tear lens and hence a weaker and thinner contact lens more easily moved and elevated by the upper lid. This pattern is not always easy to observe. However, with

practice, it can be and must be seen on every patient. Diluting the dye by instilling a droplet of water in the same manner that the dye is applied will cause the pattern to appear in those patients who have a negligible tear flow.

Instruction #3 is issued in one or two weeks when the requirements of the previous training are accomplished.

INSTRUCTION NO. 3

Instructions No. 1 and No. 2 have taught you how to control the eye and lids through the performance of the exercises. You realize now the importance of using the wetting agent properly. You also know how your participation in controlling the excitable lids, through practice of the exercises, serves to permit more comfort and a relaxed appearance.

Remember the importance of correct placement and removal. You must remove the lens that is not as comfortable as you know it should be. Clean and replace the lens. Do not wait for discomfort to disappear. Your ability to endure is not involved. Be critical of your technique. You are learning to wear corneal lenses, not learning to endure or become accustomed to corneal lenses.

You should not raise your head to protect the lenses against movement. Also, do not blink excessively or squint.

Your new schedule is as follows:

Use your lenses for two-hour periods, a minimum of three times per day and not more than five times per day.

Practice the exercises at least three, three-minute periods during each two-hour wearing period.

When removing the lenses for the last time each day, eject them into the mirror.

To repeat—At any time during a two-hour period that you feel uncomfortable or aware of your lenses, do not measure the degree of feeling. Remove, clean and replace the lenses.

Please do not alter this schedule unless you call the office first.

On each visit, the lenses are evaluated and the corneas studied with either the corneal slit lamp and microscope or a hand slit lamp. A fine convergent beam of light and a +20.00 D. lens when used in a dark room will disclose corneal staining. Enough fluorescein will always be present for this purpose following the evaluation.

Instruction #4 is issued a week or two after Instruction #3 if the patient demonstrates sufficient mastery in the performance of handling and using the lenses.

INSTRUCTION NO. 4

1. Wear your lenses *only* if they are clean and comfortable.
2. Never exceed the wearing periods.
3. If your vision becomes cloudy or blurred, remove your lenses and replace them in 15 minutes. If your vision is still blurred or cloudy, do not wear them, but call this office.
4. Inspect your lenses daily to make sure they are clean.
5. Do not wash the wetting solution from the lenses before placing them.
6. Dry your lenses before replacing them in the carrying case to keep them from sticking to the case and getting scratched or damaged.
7. You know not to squint, blink excessively, or restrict the lenses from moving freely.
8. Never change your schedule of wearing time unless you call this office first.
9. Practice the exercises frequently: at least one complete series for each one-half hour of wearing time. To help you to remember, associate the thought of exercising with some familiar thing you do, such as: answering the telephone, looking at your watch, etc. Soon you will be practicing your exercises unconsciously.

An evaluation of the lenses is performed a week after issuance of Instruction No. 4. If the cornea shows little or no staining, a second four-hour period is added to the first; then later a third and fourth four-hour period. Corneal staining may result from too rapid increment in wearing time wherein the tear fluid and air requirements of the cornea are reduced too quickly. Trapped foreign bodies are a frequent cause of irritation. Undue lid pressure upon the lenses and resultant immobilization of the lenses may cause staining. Amateur technique in placement and removal also can scratch and damage the cornea. Careless usage of the wetting fluid can terminate an apparently successful case.

Shortly before the end of the three months of training, the wearing periods coalesce and the lenses are removed only for good cause as described in the instructions. As fitting and training techniques have improved, patients are considered successful only if they wear their lenses all day every day.

Two illustrative cases follow:

Case 1: Patient, CCC; age 65, occupation retired Navy. History: On March 15, 1956, a mature cataract of the left eye was removed. The results were reported as being excellent. The visual acuity of the cataractous right eye was slowly decreasing, and it was becoming quite difficult to drive even in daylight. A contact lens was recommended by the attending ophthalmologist for use on the aphakic eye. The general health was reported as being good, and no medication was being taken at the time.

On May 13, 1957, the patient was first examined for the corneal lens fitting. The external ocular picture of the right eye disclosed two small pinguecula on the bulbar conjunctiva. The external picture of the left eye demonstrated the results of a round pupil extraction with a small surgically formed pupil at twelve o'clock in the iris. There were some insignificant lenticular capsular remnants; these were visible with the hand slit-lamp.

Ophthalmoscopy revealed a nuclear incipient cataract for the right eye; however, there were blood vessels visible through the lenticular haze. The left eye was aphakic and the retina was normal and healthy in appearance. The optic nerve head and retinal blood vessels were negative.

The final correction was:

O.D. — 1.00 D. sph. ⌒ —1.00 D. cyl. axis 145 ⌒ 3Δ base-down.

O.S. Plano ⌒ 2Δ base-up and corneal lens.

Bifocal addition: O.U. +2.50 D. sph.
The patients uncorrected visual acuity was O.D. 20/70—.
O.S. light perception only.
The patients corrected visual acuity was O.D. 20/50. O.S. 20/25.

In uniocular aphakia the corneal lens is prescribed for the aphakic eye and not for the unoperated eye. This procedure is followed in the interest of simplicity in the handling of the corneal lens case.

As described in the procedure above, the keratometer reading was modified by the examiner's constant error. Therefore a lens having a definitely increased radius of curvature for the inside curve was ordered initially. Upon receipt of the training lens, the patient was instructed on the placement and removal of his first lens and at the time that the tearing subsided, even though it was the first visit, an evaluation was made. In this particular case the diameter of the initially ordered lens was 10.0 mm.; the diameter of the final lens was 9.0 mm. It was made successively smaller in diameter according to the technique listed above. The fluorescein pattern indicated that the first lens was considerably tight; it was reduced in radius of curvature and the second training lens and all those that followed had the same radius of curvature; only the diameter and the dioptic powers were modified.

The visual acuity with the spectacle lens for the aphakic eye was 20/30. The corneal lens finally permitted 20/25 visual acuity. The patient's aniseikonic error with the corneal lens in place as tested on the space eikonometer was in excess of 7.50% overall. The eikonometer settings were not great enough to bracket the error.

There was zero stereopsis as measured with the Voerhoff stereoptor. No stereopsis was detected with the orthofusor #1. Using the stereo-orthopter, it was possible to measure first, second, and third degree fusion. Stereopsis was elicited with the arrow and circle target #11. The readings were consistent. The prism base-in to break on the stereo-orthopter was 17 prism diopters; recovery was at 3 prism diopters. The base-out to break was at 53, recovery was at 15.

With the current prescription, the patient did not experience diplopia at distance or near. His distant vision was comfortable. His near vision was somewhat confused, corrected by covering the right (cataractous) eye.

We might conclude that there was no third degree fusion, even though it was measurable on the major amblyoscope arrangement of the stereo-orthopter. Perhaps the peripheral visual stimuli were enough to elicit primitive stereopsis as a result of lifelong visual experience.

A study was made of the vertical imbalance which was subsequently corrected with the spectacle prescription. This procedure is described in the next case.

Case 2: E.M.A., age 78, occupation, housewife. The cataract had been extracted 4½ weeks prior to first visit, leaving a round pupil of the left eye. The medication following surgery had been discontinued one week previously. There was no pain in the left eye: occasionally there was a slight scratchy sensation. With the operated eye uncorrected, there was no apparent diplopia. The visual acuity of the right eye was reported as being very good. The patient was somewhat photophobic following the surgery, and she was using protective absorptive lenses. Her current prescription for the right eye was one year old. General health was reported as being good. She had pernicious anemia which was controlled with B12 and liver extract by injection. There had been a thyroidectomy performed in 1936 and she had been taking thyroid extract ever since.

The external ocular clinical picture was negative for the right eye: for the left eye it was noted that there was a round pupil with a second surgically-formed pupil at 3 o'clock. Ophthalmoscopy of the right eye revealed only slight lenticular opacities; the optic nerve head and retina were normal. Ophthalmoscopy of the left eye revealed no lesions: optic nerve head, retinal blood vessels, and the retinal eye grounds were normal. The refraction was hyperopic due to the aphakia.

The final prescription follows:

O.D. +2.75 D. sph. ⌒ —0.50 D. cyl. axis 90.
O.S. Plano ⌒ 2Δ base-up and corneal lens.
Bifocal addition: O.U. +2.50 D. sph.
The patient's uncorrected visual acuity was O.D. 20/200, O.S. light perception only.
The patients corrected visual acuity was O.D. 20/25, O.S. 20/20.

When the first training lens was ordered, it was noted that the lids were flaccid as might be expected in a patient of this age. Corneal size was average. The bulbar conjunctiva exhibited no pterygia or pinguecula. The palpebral fissure of the operated eye was unusually small, this being the result of a canthotomy performed at the time of surgery. There was average corneal prominence. There was no conjunctival injection. The position of the iris was rather high in the palpebral fissure and there was no sharp definition of the sulcus.

Due to the senile debility of the patient the usual method of placement and subsequently the method of removal had to be changed.

There were nineteen training periods in all devoted to training in placement and removal of the corneal lens. The index finger of the left hand was used to steady the upper lid of the left eye. The left thumb was placed on the temple area merely to steady the patient's hand. The lens was prepared by the thumb, index finger, and forefinger of the right hand. The forefinger of the right hand was used to open and steady the lower lid and the lens was carried to the cornea by the index finger of the right hand.

The removal of the lens was most difficult. When pressure was applied to the external canthus with the index finger of the right hand, the eyelids were pulled over the cornea and exerted no pressure whatever on the corneal lens. In order for the eyelids to exert pressure on corneal lens and at the same time to be held open enough to permit the lens to be removed from the eye, the index finger of the left hand was positioned at the external canthus and the index finger of the right hand was positioned at the internal canthus; and then with a steady pressure posteriorly and away from the cornea, the lens was finally retained between the two margins of the lids so tightly that it was ejected.

The inside radius of curvature of the original training lens had to be increased by 0.20 mm., in order to present the desired fluorescein pattern. The diameter of the lens was decreased from 9.8 mm. to 8.8 mm. The final visual acuity for the left eye was 20/20, and for the right eye the visual acuity remained at 20/25. This patient demonstrates third degree fusion on the stereo-orthopter, but this was not measurable with the Voerhoff stereopter. The aniseikonic error in this case was again in excess of 7.5 overall magnification. This would account for the lack of true stereopsis.

Vertical prism was required in the final spectacle prescription in order to maintain easy single simultaneous binocular vision. It was assumed that the downward displacement of the corneal lens was the cause of this vertical phoria. It was not possible to change appreciably the quantity of the vertical phoria by changing the diameter and hence the thickness of the corneal lens. It was expected that the larger lens would produce a greater vertical displacement. This did not occur. However, the origin of the vertical phoria was proven to be just the presence of the lens, for with the Mattox rod test wherein the operated eye without any correction viewed a small light source at 20 feet and the unoperated eye viewed just the horizontal streak, there was no vertical phoria. The patient's final prescription included 2 prism diopters base-up correcting the base-down prism introduced by the contact lens.

SUMMARY

The contact lens correction of aphakic patients appears to be the method of choice at this time. In the correction of binocular aphakics, we achieve optical benefits including a greatly increased field of view, freedom from distortion of the visual field, and the possibility of better binocular coordination, when the thick cataract correction spectacle lenses are eliminated. The optical considerations in the case of uniocular aphakia are even more important in consideration of the fact that the anisekonic error is reduced so that quite adequate fusion is possible.

The mechanical advantages consist of the elimination of the heavy cataract spectacle lenses and the relative stability of the correction with contact lenses. All of these benefits result from the use of contact lenses all day every day. But this itself is wholly dependent upon the skill of the practitioner in his fitting of the contact lenses and especially his skill in the training of the patient in their proper use. The procedures described above are essentially those devised by Kevin M. Touhy.

1350 GARNET AVENUE

SAN DIEGO, CALIFORNIA

REFERENCES

1. Rosenbloom, Alfred A., The correction of unilateral aphakia with corneal contact lenses. Am. J. Optom. and Arch Am. Acad. Optom., 30 (10): 536-542, 1953.
2. Berens, Conrad, Louis J. Girard, and Kenneth Foree, Corneal contact lenses: a clinical investigation. Trans. Am. Ophth. Soc., 50: 55-75, 1952.
3. Hirtenstein, A., Contact lens in unilateral aphakia. Brit. J. Ophth., 34 (11): 668-674, 1950.
4. Goar, Everett L., Contact lenses in monocular aphakia. A. M. A. Arch. Ophth., 58 (3): 417-420, 1957.
5. Solex Service Method Bulletin. Los Angeles, Calif., Solex Laboratories, Inc.

ANNOUNCEMENT

CONTACT LENS COURSE AT INDIANA UNIVERSITY

The Division of Optometry, Indiana University will give a Contact Lens Course on the campus in Bloomington, January 26-29, 1959. Thirty hours of instruction will be provided. The instructors will be Charles Shick, O.D., and William Baldwin, O.D. of the faculty. The tuition is $60.00 and a certificate of completion will be awarded by the Indiana University upon the conclusion of the course. Application for enrollment must be made in advance to Merrill J. Allen, O.D., Associate Professor, 104 Myers Hall, Indiana University, Bloomington, Indiana.

STUDIES OF FIXATION DISPARITY

II. APPARATUS, PROCEDURE AND THE PROBLEM OF CONSTANT ERROR*

Darrell B. Carter†
College of Optometry, University of Houston
Houston, Texas

The literature on fixation disparity has been previously reviewed by the author.[2]

The purposes of the studies being reported in this series of articles were to study (1) the division of fixation disparity between the two eyes, (2) the variation of fixation disparity with forced vergence induced by base-out and base-in prism, and (3) the quantitative changes in fixation disparity and in heterophoria with prolonged wearing of prisms. These three topics will be considered in the subsequent articles of this series.

The technique adopted for this experiment was similar to that used by Ogle and his co-workers to measure fixation disparity. It consisted of having the subject adjust two monocularly seen lines until they appeared to be aligned. The lines were thus presumably stimulating corresponding meridians on the two retinas. The experimenter then measured the physical misalignment of the lines. Sensory fusion was maintained by the binocular portions of the targets being presented to the two eyes.

The technique is based on the assumption that even with sensory fusion occurring in most of the visual field, monocular lines are directionalized by the primary subjective visual direction of the area of the retina on which their images fall. Corresponding meridians of the retinas have been determined when the lines are perceptually aligned. To the extent that the above assumption is not correct, any subjective measurement of fixation disparity is invalid.

Fixation disparity was studied in this experiment under two basically different situations. In the first situation, the only fusion clues were at least 0.75 degrees peripheral from the center of the visual field. Fixation disparity under these conditions is termed peripheral fusion

*This article is an abridgment of part of the dissertation, *"Studies of Visual Fixation Disparity,"* submitted in partial satisfaction of the requirements for the Ph.D. degree in the Graduate Division of the University of California, Berkeley, California, January, 1957. Submitted on February 10, 1958, for publication in the November, 1958, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist. Ph.D., Member of faculty. Fellow, American Academy of Optometry.

fixation disparity. In the second situation, a central vertical line was seen binocularly in addition to the peripheral fusion clues. Fixation disparity under these later conditions is termed central fusion fixation disparity.

APPARATUS

The subject was seated at a small table upon which was fixed a chin cup and head rest. A phorometer having rotary prisms each adjustable to 30 prism diopters was placed so it could be adjusted before the subject's eyes. Opaque discs having square-shaped apertures oriented 45 degrees from each other so as to prevent sensory fusion were placed in the lens holders nearest to the subject's eyes. Figure 1.

The visual field of the subject looking through the above apparatus consisted of the target screen surrounded by a blank dull wall. The screen, 48 inches by 70 inches, with the long dimension vertical, rested against the end of a table. On the table were two metal boxes, one above the other, each containing two 15-watt incandescent lamps. Adjustable slits at the front of each box provided the test vernier lines. A sheet of frosted glass made the slits appear homogeneous. The lower box could be moved laterally by means of a worm gear.

A rectangular black mask, subtending 3 degrees vertically and

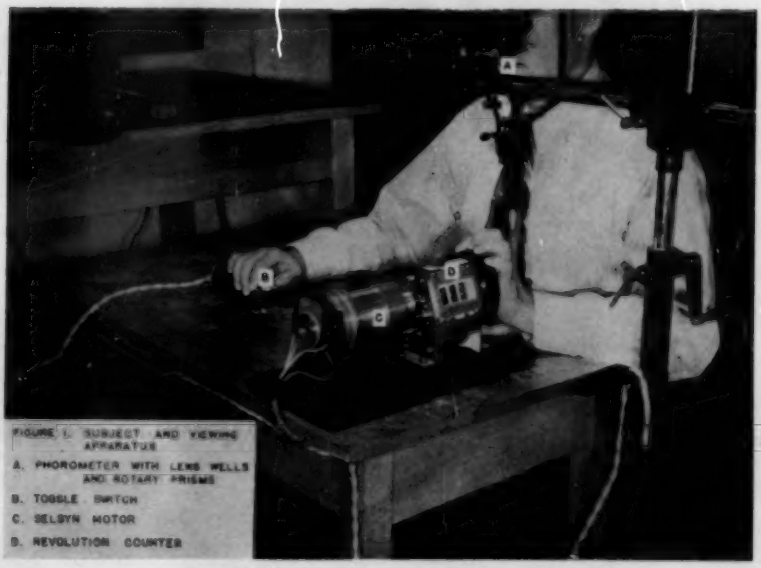


FIGURE 1. SUBJECT AND VIEWING APPARATUS

A. PHOROMETER WITH LENS WELLS AND ROTARY PRISMS

B. TOGGLE SWITCH

C. SELSYN MOTOR

D. REVOLUTION COUNTER

1.5 degrees horizontally, was attached to the center of the screen. Both the mask and the screen had holes cut through them so that the test lines could be seen by the subject. With a low general room illumination, the mask appeared as a completely homogeneous black area.

The subject thus saw a small black field upon which were two lines oriented vertically one above the other. Figure 2. A binocular

FIGURE 2. TARGET APPARATUS AS SEEN BY THE SUBJECT
E. PROJECTION SCREEN AND CRISSCROSS FUSION PATTERN
F. CENTRAL BLACK FIELD AND VERNIER TEST LINES

fusion pattern was projected upon the screen surrounding the black field. The top test line was stationary and at 430 centimeters from the subject's eyes, the distance used throughout the entire experiment; it subtended 33.6 minutes of arc in height. The bottom line subtended 29 minutes of arc. The width of both lines was 1.6 minutes of arc. The separation between the lines was 10.4 minutes of arc. The lines were not placed closer together for mechanical reasons and also because of the statement by Ames and Gliddon that the directionalization of a monocular retinal image situated just adjacent to a binocularly fused image would not necessarily be by the primary subjective visual direc-

tion of the area of the retina being stimulated by the monocular image. The lines were of the same apparent brightness.

The peripheral binocular fusion pattern was provided by projecting upon the upper portion of the screen a pattern approximately 48 inches horizontally by 44 inches vertically of diagonal lines of a crisscross character, the separation between each two parallel lines being 20 centimeters. The pattern was not projected on to the black mask attached to the center of the screen. The light coming from the two vernier test lines was polarized by strips of H-Poloroid attached in front of the slits. The polarization of one was perpendicular to that of the other.

The bottom line was not illuminated constantly but instead was flashed on for 0.25 seconds by an electronic timer. The timer was activated by a toggle switch which could be thrown by the subject. It had been concluded from a preliminary study that a flash period of 0.25 seconds was about optimal for fixation disparity settings.

A Selsyn motor fixed to the worm gear shaft of the bottom box was coupled to another motor placed on the subject's table. Attached to this motor was a mechanical revolution counter so that the position of the bottom line could be read at the subject's table. The subject could conveniently and precisely adjust the position of the lower line by means of the Selsyn motors. The maximum error of the apparatus, almost all of which was in the back-lash of the worm gear, was estimated to be 0.1 millimeter, or 0.08 minutes of arc at 430 centimeters.

For measuring fixation disparity, under conditions of peripheral sensory fusion only, a poloroid disc was placed in the phorometer lens well before each eye. The discs were orientated so that the right eye could see only the top line and the left eye only the bottom line.

Fixation disparity under conditions of both central and peripheral sensory fusion was determined by measuring the two uniocular components. During these uniocular determinations, a disc of H-Poloroid was placed in the phorometer lens holder in front of one of the subject's eyes. The disc was oriented so that it blocked off the polarized light of the bottom vernier line. A Wratten number 96 (neutral density) 0.2 filter was placed before the eye being tested so as to equalize for the two eyes the apparent brightness of the binocularly seen top vernier line and the crisscross fusion pattern.

During the various experimental runs, subjects wore the ophthalmic lenses which gave them the best obtainable visual acuity. Fixation disparity settings were taken at various convergence and divergence stimuli by varying the power of the rotary prisms of the phorometer.

PROCEDURE

To measure the apparent uniocular component of fixation disparity for either eye, the monocularly seen bottom vernier line was perceptually aligned with the binocular top line. The physical misalignment measured the apparent fixation disparity of the eye seeing the bottom line.

The subject was instructed to fixate the top line and to adjust the position of the bottom line until the two lines appeared to be aligned. The adjustment was made by turning with one hand the plastic disc attached to the control Selsyn motor. The subject held in his other hand a tube upon which was mounted the toggle switch which flashed the bottom line.

Each subject made a number of practice settings before each experimental run was started. An attempt was made to have the subject make each setting in about 30 seconds. A flash rate greater than one flash per second was not allowed. Most experienced subjects could make a setting that they considered to be correct in 30 seconds, having flashed the bottom line about 20 times during the "tuning" procedure. Subjects attempted to align the lines by moving the bottom line until it appeared directly under the top line on three consecutive flashes. With some subjects the bottom line never appeared exactly under the top line; they adjusted the bottom line until it would appear equally to the right and left on successive flashes.

THE PROBLEM OF CONSTANT ERROR

At the start of the experiment, it was found surprisingly that most subjects did not usually have the mean of a series of binocular vernier settings in which both lines were seen by both eyes at the position of physical alignment of the two lines, but rather, the mean position was significantly to the right or left. The amount and direction of this constant error of alignment varied from subject to subject but was fairly stable for any one subject. Even subjects long trained in visual experimentation, had appreciable constant errors.*

About one-half of all subjects had vernier constant errors such that the mean of a series of vernier alignment settings would place the bottom line physically to the subject's right. About one-fourth of the subjects tested showed a constant error of the bottom line to the left, while another one-fourth did not show an appreciable constant error when compared to the standard deviation.

Examples of consistent right and left vernier constant errors are the results of subjects RH and CN. Data taken over a period of several

*The reader is referred to the appendix of the original dissertation for a complete tabulation of data for each subject.

weeks showed as means in minutes of arc and standard deviations in minutes of arc of 10 settings: subject RH—0.34R ± 0.17, 0.33R ± 0.16, 0.12R ± 0.20, 0.59R ± 0.21, 0.49R ± 0.12, 0.25R ± 0.09; subject CN—0.17L ± 0.29, 0.20L ± 0.16, 0.22L ± 0.32, 0.17L ± 0.22, 0.40L ± 0.15. Both of these subjects have had considerable experience in visual experimentation.

The largest vernier constant error of any of the 23 subjects was 0.90R ± 0.28. This was by MF, who also has had considerable experience in visual experimentation. However, several other constant errors of over 0.8 were recorded.

While it is possible that some of the constant errors of vernier alignment could have been the result of an undiscovered error in the alignment of the instrument, this is doubtful, as careful and repeated checks of the alignment were performed to avoid this possibility. The physical alignment could be determined to an accuracy of about 0.08 minutes of arc.

The cause of this surprising phenomenon was never ascertained. It persisted in spite of removal or change of the peripheral fusion pattern. It did not depend on the direction of misalignment of the lines at the start of each setting, nor did it depend on which hand turned the disc controlling the Selsyn motor. It persisted when the bottom line was on continuously rather than being flashed.

A hint of the same phenomenon was given by Ogle[4] in reporting his procedure in measuring fixation disparity. He adjusted the zero reading of his fixation disparity apparatus to the position for which "the subject reported that the arrows were in alignment" during binocular vernier alignment settings. He stated that "this procedure eliminated any constant personal and instrument errors, although almost no variations were found between subjects." However, Ogle apparently determined fixation disparity values to the nearest one minute of arc. All of the constant errors found in the present investigation were less than one minute of arc. As readings could be accurately made to 0.1 minute of arc during the present investigation, small constant errors would be more apparent if present.

The only other mention of a constant error in a vernier alignment situation that the present author has been able to discover was that of Emsley[3] (p. 499). Emsley, using five subjects, reports constant errors in monocular settings of up to 0.8 minutes of arc. He stated that similar results were obtained when the vertical lines of the test target were replaced by two rows of dots. In a personal communication, Berry[1] commented that in his experimental work on vernier acuity he

obtained the impression that a constant error existed in vernier discrimination. However, he expressed surprise at the magnitude of the constant errors found in the present investigation.

The existence with some subjects of vernier alignment constant errors approaching the order of magnitude of the apparent uniocular components of fixation disparity creates a problem in deciding whether a physical misalignment of the apparatus when the test lines are perceptually aligned is really the result of a fixation disparity. That fixation disparity measurements should be calculated from the position of perceptual alignment rather than from true physical zero is indicated by the observation that calculation from perceptual zero nearly always resulted in a more nearly equal division of fixation disparity between the two eyes.

There were 42 experimental runs of 17 subjects, in which were made at least 10 settings each of binocular vernier alignment, right eye fixation disparity, and left eye fixation disparity, all three taken with the convergence demand being that of the target. In 8 of the 42 settings, the mean of the vernier alignment settings to the nearest 0.1 minute of arc was zero. Thus perceptual zero and physical zero coincided. In the 34 runs in which perceptual zero of vernier alignment differed from physical zero, calculation of the uniocular components from perceptual zero rather than physical zero made the means of the left and right eye components equal in 2 runs and reduced the difference between the left and right eye components in 25 runs. In 5 additional runs, calculation from perceptual zero overcompensated the difference between the uniocular components, so that the one that was more eso was now less eso, but the resultant difference was less than the difference between the two components calculated from physical zero. In one run, calculation from perceptual zero overcompensated the difference between the two components to such a degree that the resultant difference was greater than the difference using physical zero. In only one case did calculation from perceptual zero increase in the same direction the difference between the uniocular components.

Similarly, study of the curves of the uniocular components of fixation disparity plotted against prism vergence showed that calculation from perceptual zero, when the perceptual and physical zeros differed, tended to reduce any displacement of one curve relative to the other. Whether perceptual or physical zero is used for calculation of the apparent uniocular components has no effect on the total amount of central fusion fixation disparity as the total amount of central fusion fixation disparity is determined by adding together the apparent uniocular components.

Whether perceptual zero or physical zero is used to calculate the magnitude of peripheral fusion fixation disparity is of little importance because of the small values of the constant error of vernier alignment relative to the usual magnitude of peripheral fusion fixation disparity.

The division of fixation disparity between the two eyes can be judged from the position of the curves for the right and left eyes relative to the base line of zero fixation disparity when the values of uniocular fixation disparity are potted against forced vergence. However, because of the existence of vernier alignment constant errors of appreciable magnitude, the relative positions of the right and left eye component curves may be an artifact. A better judgment of whether fixation disparity is or is not divided between the two eyes may be made from whether or not both of the uniocular components vary to the same extent with forced vergence. With those subjects who do not show an appreciable variation of central fusion fixation disparity with forced vergence, a meaningful evaluation of the apparent division of fixation

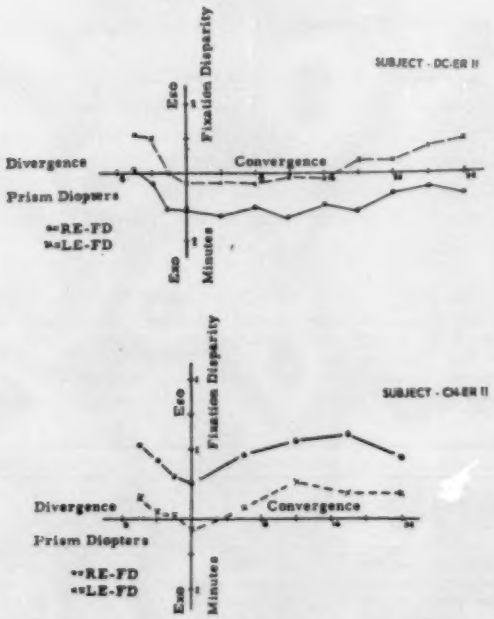


Fig. 3. Examples of data of subjects whose curves for the right and left eye components of fixation disparity probably are shifted apart by an uncompensated vernier constant error.

disparity between the two eyes is not possible because of the problem of constant error.

Examples of the effect on the forced vergence curves of the right and left eye components of fixation disparity from an uncompensated vernier constant error are probably offered by the results of experimental runs of subject DC (Subject DC-ER II) and subject CN (Subject CN-ER II). In both of these runs, the apparent right and left eye component curves run parallel to each other but are shifted apart, one component in the eso direction and the other in the exo direction. (Fig. 3.)

In these two cases only a small constant error of vernier alignment was found in the binocular vernier settings. It is difficult, however, to explain these two sets of curves except on the basis of an undisclosed vernier constant error. The apparatus was checked for alignment after each of these sets of apparently anomalous results had been obtained, and no instrument error was found.

SUMMARY

The apparatus and procedure used in determining fixation disparity are described.

As a preliminary step in measuring fixation disparity, binocular alignment settings were made. It was found surprisingly that with most subjects the mean of a series of vernier settings did not coincide with the position of physical alignment of the lines of the target.

The incidence and magnitude of this phenomenon of constant error is discussed, as well as its effect on the measurement of the uniocular components of fixation disparity.

REFERENCES

1. Berry, R. N., Personal Communication, May 4, 1954.
2. Carter, Darrell B., Studies of fixation disparity—historical review, Am. J. Optom. and Arch. Am. Acad. Optom., 34 (6): 320-329, 1957.
3. Emsley, H. H., Visual Optics, 4th ed. London, Hatton Press, 1946.
4. Ogle, Kenneth N., Researches in Binocular Vision. Philadelphia, Pa., W. B. Saunders Co., 1950.

ANNOUNCEMENT

ASSOCIATION OF MILITARY OPTOMETRISTS OF THE UNITED STATES

Dr. Robert J. Johnson, Latrobe, Pennsylvania, president, Association of Military Optometrists of the United States, has called the annual meeting of the Association for Sunday afternoon and evening, December 14 at the Statler-Hilton Hotel, Boston. All members and active duty, Reserve and former commissioned personnel are invited to be present and discuss the status of Military Optometry.

ACCOMMODATION LEVELS DURING NEAR CROSSED-CYLINDER TEST*

Gerald Westheimer†
School of Optometry, The Ohio State University
Columbus, Ohio

The near crossed-cylinder test consists of the presentation to the patient of a grid as illustrated in Figure 1 at a distance of, say 40 cm.

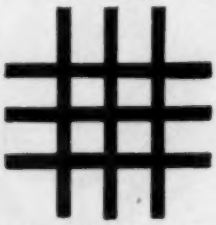


Fig. 1. Near Crossed-Cylinder Test Target. The lines were seen transilluminated in white against a completely dark background. (Enlarged)

from his eyes, the placing of a crossed-cylindrical lens such as a +0.50 D. sph. ⊃ —1.00 D. cylinder x 90 in front of the eye, and the addition of spherical lenses in front of the eye until the patient judges the horizontal and vertical lines of the grid to be equally clear. The test may be carried out either monocularly or binocularly but in the present study only the monocular procedure is analyzed. It is presumed throughout, of course, that the patient's distance ametropia has been satisfactorily corrected before the test is begun. If his accommodation is fully adjusted for the near testing distance and the crossed-cylinder lens is placed before the eye, both the horizontal and vertical lines of the target will be equally blurred. If the eye is over-accommodated for the target the vertical lines will appear clearer and if the eye is under-accommodated for the target the horizontal lines will appear clearer. This is described in detail in standard textbooks.[1]

This test is widely regarded as a measure of the accommodative stance assumed by the patient when confronted with the near viewing situation represented by the card with the grid at the distance of 40 cm. The validity of this test then revolves around the question of

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 7, 1957. Supported by The Office of Naval Research under Contract Nonr 495(09) NR 140-105 with the Ohio State University Research Foundation. For publication in the November, 1958, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist. Ph.D. Member of faculty. Fellow, American Academy of Optometry.

whether the patient will usually permit his accommodation to "dangle" during the test or whether the fact that one or the other of the set of lines can be made clear by a suitable accommodative adjustment will act as an artificial stimulus to accommodation.

APPARATUS

The apparatus used in the experiment (Figure 2) has been described

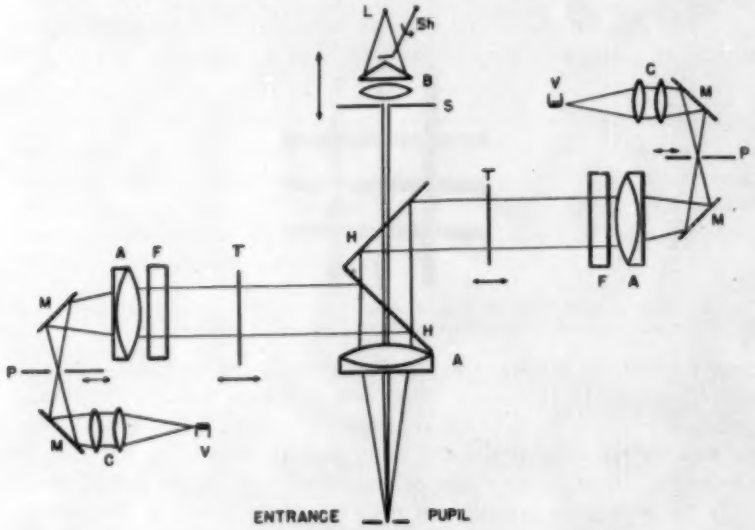


Fig. 2. Apparatus used to introduce targets and measure accommodation. The components L, Sn, B, S form a coincidence optometer. Two identical beams, one on the right and one on the left, are brought together by a system of half-silvered glass plates, H, and are focused along with the coincidence optometer beam in the entrance pupil of the eye by means of an achromatic lens A. Components V, C, M serve to illuminate the targets, and P is a focal plane shutter. The targets are placed at T in the beams and the accommodative stimuli they represent depend on their distances from the lens, A. The details of the apparatus and of the coincidence optometer method of measuring accommodation have been described elsewhere.[2]

previously.[2] Briefly it consists of three separate optical beams all entering one eye. Two of these beams are identical, each permitting the presentation to the subject of a target transilluminated by a white parallel beam of light and seen in Maxwellian view. The accommodative stimulus of these targets may be varied over a wide range without changing the retinal illuminance or size. Either or both of the targets may be illuminated at a time. The third beam represents a coincidence optometer which permits the accommodative level of the eye to be determined by a bracketing procedure. This beam was flashed into the

eye only briefly (0.05 second) at variable intervals, usually about 7-10 seconds, thus allowing the patient to observe the stimulus target without the distraction and possible accommodative stimulation of the measuring beam. Even if the subject did accommodate to the measuring beam, the presentation of the latter had already been completed before such an accommodative response would have started and the results, therefore, may be regarded as minimally contaminated with this possible error. It is usually possible to localize the accommodative level within a range of 0.2 to 0.3 diopters with this method.

The targets used in this investigation were a set of three vertical lines placed in one beam and a set of three horizontal lines in the other beam. When both targets were illuminated they had the appearance of the grid shown in Figure 1. The angular subtense of the lines at the eye was equivalent to that of 0.8 mm. thick lines at 40 cms. Preliminary tests with lines of only one-tenth the thickness had shown similar results. Each of the set of lines could be placed at any one of a given range of dioptral positions. The coincidence optometer target was flashed into the eye so that it was seen just below the horizontal lines of the target.

When the accommodative level was not adjusted to the accommodative requirements of the target, the latter was defocused and usually reported by the subject to be somewhat blurred. The images of the sources in the pupil were small so that no artificial pupil was necessary. The retinal light distribution of a defocused target in Maxwellian view has never been computed, but it is believed to show most of the typical characteristics of that of an equivalent incoherent target.

RESULTS

Results were obtained from eight subjects, all optometry or graduate students in their twenties. They all had good accommodation and were either emmetropic or fully corrected low hyperopic astigmats. With one or two exceptions they were unaware of the nature of the experiment.

The horizontal lines were placed so that they required between 0.0 D. and 2.0 D. accommodation to be accurately in focus and the vertical lines were placed so that the accommodation required for them was between 1.5 D. and 2.0 D. more than that for the horizontal lines. This relatively large difference was adopted because preliminary tests showed no detectable difference in accommodation when the difference in stimulus was very much smaller.

The subjects were first shown the horizontal lines and the accommodative level determined. This took about 30-60 seconds. The

measurement of the accommodative response to the vertical lines came next, followed by the measurement of accommodation when both sets of lines were presented. The whole procedure was usually repeated several times, with various permutations of the horizontal-vertical-both sequence.

The accommodative responses to the horizontal and vertical lines differed by more than 0.5 D. in only one case and often no difference in response level could be detected within the error of measurement. The absolute response level thus depends only slightly on the level of accommodative stimulation and this was shown also in the fact that a parallel dioptric shift of both sets of lines usually left the response levels more or less unchanged. The accommodative response to the simultaneous presentation of both sets of lines was usually at a level somewhere between those for the two individual sets of lines but sometimes it coincided with that for one of the sets. Occasionally there was a definite fluctuation between the two levels. No great stress was placed in the present experiment on the subjective experience of the observer but in so far as it was volunteered or ascertained by specific questions at the conclusion of a run, it confirmed the fact that the appropriate set of lines was somewhat out of focus.

DISCUSSION

Care must be taken to view the results in their proper perspective. While the subjects formed a small and rather selected group, the nature of the findings does not suggest that they would be radically different for the average patient. In other words, if the visually sophisticated observer does not make an attempt to accommodate on a line target, there is no reason to believe that the average patient will respond in a more refined manner. The most important difference between this experiment and a standard testing situation is the fact that in the latter the chart with the target is distinctly located in space.

There is reason to believe that such factors as apparent spatial localization play a major part in the establishment of the accommodative level. The relationship of these factors to the strictly optical factors, i.e., minimization of blur, remains as yet not fully determined, but the present experiment shows again that even under highly abstracted conditions of optical stimulation the strict focusing of a target is not by any means the only, or perhaps even a good, determinant of accommodative level.

Applied to clinical procedures, the following conclusions might be drawn. When presented with a near viewing situation, such as a near point chart at 40 cm., the patient will assume an accommodative

stance dependent on many factors. The crossed-cylinder test is probably excellent in determining whether a patient is over or under-accommodated for the distance. When a crossed-cylinder lens is placed in front of the eye while the patient is observing the grid, the immediate response of whether the horizontal or vertical lines are clearer will give this information. The evidence points to the conclusion that the average patient will retain his previously established accommodative level even during subsequent attempts by means of lenses to make both sets of lines equally clear, since he will usually not change his accommodation to retain clarity of one or the other sets of lines. There may, however, be individual differences; the actual finding of the plus or minus lens for equality of the lines may not be quite as valuable as the original determination of the direction of accommodative deviation from the level required for the observation distance.

Under these circumstances the following modification of the test would seem in order: Have the patient observe whether the horizontal or vertical lines are clearer when he watches the chart and a crossed-cylinder lens is suddenly introduced. Remove the crossed-cylinder immediately. If, for example, the horizontal lines were said to be clearer, introduce the crossed-cylinder again, this time in association with, say, a +0.50 D. sph., and repeat with various spherical lenses until that spherical lens is found which when suddenly introduced in combination with the crossed-cylinder leaves the two sets of lines equally clear. In this way the basic situation of the unaided observation of the grid is interrupted only briefly and then only for a single judgment of relative clarity. In presbyopia and other cases in which there is no reason to suspect an active accommodative change in the direction of maintenance of focus adjustment on the one or other set of lines, the standard procedure seems adequate.

SUMMARY

An experiment is described in which accommodation levels are measured in young subjects when presented with a visual configuration consisting of a set of three horizontal lines at one optical distance and a set of three vertical lines at a different optical distance. The responses obtained suggest that clarity of one or the other set of lines is not the main determinant of accommodative level. It seems that the use of the monocular crossed-cylinder test for near accommodation level should yield satisfactory results. A modification of the test is suggested which would avoid the possible accommodative action to maintain clarity of one set of lines, but in the average case it is doubtful whether this action constitutes a significant factor.

REFERENCES

1. Borish, Irvin M., Clinical Refraction, 2d ed. Chicago, Ill., Professional Press, 1954, p. 331.
2. Westheimer, Gerald, Accommodation measurements in empty visual fields, J. Opt. Soc. Am., 47 (8): 714-718, 1957.

AMERICAN ACADEMY OF OPTOMETRY

CHAPTER ACTIVITIES

The British Chapter, American Academy of Optometry, wishes to invite optometrists to attend the next London Course of Optometry which will be held May 26 through June 23, 1959, at the Rotary House, London. This post-graduate course is planned to acquaint optometrists of other lands with the latest British methods and equipment. For information and application form write to Mr. C. S. Flick, Panton House, 1, Howard Street, London, W.C.2., England.

Dr. Ester Ingram McQuarrie, Winter Haven, was reelected president of the Florida Chapter, and Dr. H. C. Bumpous, St. Petersburg, was reelected secretary-treasurer at its mid-summer annual meeting. Dr. Donald A. Springer, Anniston, was the guest speaker.

A combined business and educational meeting of the New England Chapter was held on October 1 at Springfield, Massachusetts. At this meeting Dr. William B. Dorfman, Bristol, Connecticut, was elected chairman; Dr. Milton L. Palmer, Springfield, Massachusetts, vice-chairman and Dr. Thaddeus W. Bartles, Bristol, Connecticut, secretary-treasurer. Dr. Ralph H. Green, dean, Massachusetts College of Optometry, was the speaker.

The San Gabriel Valley (California) Chapter has elected the following officers: Dr. Gordon E. Lewis, Pasadena, president; Dr. Daniel L. D'Arry, Sierra Madre, vice-president and Dr. Solon M. Braff, El Monte, secretary.

The South Carolina Chapter has elected the following officers: Dr. Ned P. Hobbs, Darlington, president; Dr. William C. Ezell, Spartanburg, vice-president and Dr. B. B. Parks, Greenville, secretary-treasurer.

AMERICAN JOURNAL OF OPTOMETRY
and ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 35 November, 1958 No. 11

EDITORS AND STAFF

Dr. Carel C. Koch ..... *Editor*
Dr. Monroe J. Hirsch ..... *Associate Editor*
Dr. Rudolph Ehrenberg ..... *Advertising Manager*
Terry Judith Parkins ..... *Editorial Assistant*
Grace Weiner ..... *Bibliographic Editor*

Publication and Academy Office: 1508 Foshay Tower, 821 Marquette Ave.
Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $8.00 in Advance; Foreign, $9.00; Single Copies 80c

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

The American Academy of Optometry and the publishers of this journal have no objection to the reprinting by other magazines of any of the articles in this issue, provided such reprints are properly credited to the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

ACADEMY POST-GRADUATE COURSE — 1958

One of the outstanding characteristics of optometry is the large number of optometrists who regularly participate in various forms of post-graduate education. This is a significant mark and indicates a widespread desire to continually provide better and better visual care to society. In keeping with this desire and to further education in optometry, the Academy has sponsored post-graduate courses as an integral part of its regular annual meeting for the past four years.

This year the courses are offered during the first three days of the annual meeting at the Statler-Hilton Hotel in Boston, December 10-12.* They consist of 134 hours of instruction in fifty-five (55) courses. Not only is this the largest number of courses ever provided at a single meeting but it also is the most extensive on the basis of the number of hours of instruction. Relevant data for prior years are as follows:

*For the schedule of courses, hours, cost, and a detailed review of each course, write to Dr. D. G. Hummel, 1318 National City Bank Bldg., Cleveland, Ohio, or refer to pages 438-448, August, 1958, issue of this publication.

Year	Number of Courses	Hours of Instruction
1955	40	104
1956	42	108
1957	52	124
1958	55	134

Prior to sponsorship of post-graduate courses, the Academy spent no less than two years carefully studying the advisability of such courses; factors such as the need, available instructors, length of courses, cost, location, relation to the general meeting, number of courses, remuneration of instructors, and variety and level of courses all were studied carefully and evaluated. It was then decided to offer the courses substantially in the same pattern or form followed since their inception.

The Academy post-graduate courses are unique; in general, the courses are short in length, specific in content, reasonable in cost, and taught by instructors of renown. For example, although the program this year consists of fifty-five courses, no single course is more than twelve clock hours in duration; the majority of courses are from one to three hours in length and, as a general rule, these hours are not continuous. In addition, an instructor is not responsible for more than three courses during the three-day period of the courses and usually an instructor will participate only in one or two courses. These procedures obviously promote the highest quality of instruction.

The courses are varied in content and although some courses chiefly are theoretical in nature, the majority are very practical. This is evident from a study of the many different courses in each of the ten areas of broad general interest. These areas are refraction, pathology, practice management, contact lenses, subnormal vision, orthoptics and vision training, occupational vision, school vision, aniseikonia, and ophthalmic dispensing.

The specific courses in each area are as follows:

REFRACTION

Course Number	Subject	Instructor
1	Subjective Testing Procedures	Allen
2	Prism Prescription for Lateral Imbalance	Allen
8	Absorptive Lenses	Cline
11	Streak Retinoscopy	Copeland
29	Multifocal Lenses for Anisometropic Patients	Hirsch
31	Differential Diagnosis of Myopia	Kratz
35	Turville Infinity Balance Test	Morgan
49	Management of the Cataract Patient	Sinn and Simmerman
52	House Calls: Examination and Fitting of the Invalid	Stewart
54	Use of Polarization in Ophthalmic Practice	Wright
55	Geriatric Optometry	Wick

PATHOLOGY

7	Pathology of the Cornea	Bruce

Course Number	Subject	Instructor
20	Vision Discomfort—Role of Glare	Fry
27	Screening of Visual Fields with Multipattern Test Targets	Hebbard
28	Ocular Pathology Review	Section on Pathology
34	Introduction to Slit Lamp Microscopy	Mazow
42	Illustration of Ocular Pathology	Prince
45	Headaches of Ocular Origin	Roy
55	Geriatric Optometry	Wick
	PRACTICE MANAGEMENT	
5	Accounting and Office Procedures	Bebber
9	Review and Evaluation of Reminder Systems	Connolly and Hathaway
13	Practice Management	Dick
24	Optometric Participation in Community Health and Welfare Programs	Haffner
30	Practice Management for Inter-Professional Relations	Hofstetter
39	Prepaid Optometric Services	Peters
	CONTACT LENSES	
7	Pathology of the Cornea	Bruce
17	Corneal Physiology and Contact Lenses	Finkelstein
22	Advanced Course on Corneal Lenses	Graham, Feinbloom and Mazow
38	Modern Contact Lens Fitting	Neill and Associates
	SUBNORMAL VISION	
15	Subnormal Vision and Clinic	Feinbloom, Filderman and Williams
16	The Physiological Optics of the Partially Blind Eye	Feinbloom
41	Subnormal Vision	Policoff and Rosenbloom
55	Geriatric Optometry	Wick
	ORTHOPTICS AND VISION TRAINING	
2	Prism Prescription for Lateral Imbalance	Allen
4	Visual Training and Speed Reading	Anapolle
21	Amblyopia	Giglio
26	Haploscopic Testing of Binocular Vision	Heath
33	Clinical Aspects of Ocular Motility	Mark
36	Unfavorable Prognostic Conditions in Strabismus	Morgan
46	Latent Binocular Stress and Prolonged Monocular Occlusion	Roy
	OCCUPATIONAL VISION	
12	Occupational Vision in the Army	Eschbach
14	Occupational and Motorist Vision Programs	Feinberg and Sherman
23	Lighting Design for Effective Working	Guth
40	Communications in Eye Safety Programs	Peters
47	Practical Aspects of Industrial Optometry	Sager
53	Vision Problems in the Navy	Vasa
	SCHOOL VISION	
4	Visual Training and Speed Reading	Anapolle
6	Vision Care of Children	Bing
25	Color Deficiency in School Children	Heath
44	The Optometrist's Role in the Reading Program	Rosenbloom
	ANISEIKONIA	
10	Signs and Symptoms of Aniseikonia	Connolly
43	Design of Aniseikonic Corrections	Rayner
48	Retinal Images	Sheard
51	Space Eikonometer Technique of Measuring Aniseikonia	Springer
	OPHTHALMIC DISPENSING	
3	Basic Principles in Fitting Prosthetic Eyes	Alton
19	Evaluation of Quality in Ophthalmic Lenses	Fry
32	Recent Developments in Ophthalmic Dispensing	MacLeod
37	Adjusting Modern Ophthalmic Frames	Namias
50	Characteristics of Multifocal Lenses	Sinn
52	House Calls: Fitting of the Invalid	Stewart

As one might surmise, the problem of scheduling such a large number of courses in three days to meet the needs of individual instructors as well as the avoidance of conflicts for courses in the same area is no easy task. Nevertheless, the schedule was developed with these objectives in mind and except in several minor instances, none of the courses in a given area conflict with related courses in the same area. As a consequence, one can take all the courses in a given area of interest without a conflict of schedule. However, if courses in different areas of interest are taken, particular care must be exercised to avoid problems of scheduling.

The spirit of fellowship prevading academy meetings is traditional. This is due not only to a willingness to share insight, knowledge and experiences but also a desire to do so. Although this attitude generally is shared by all at a meeting, it is especially evident in the instructors who participate in the post-graduate courses. It is they who have established the high quality of instruction in the courses and who consistently have assured their success. With such a proven record, surely one would be very remiss if full advantage was not taken of this educational venture.

One last note. Since the Academy is dedicated to the advancement of research and education in optometry, the courses are open to any registered optometrist regardless of Academy affiliation; however, membership in the American Optometric Association is considered a prerequisite.

V. J. ELLERBROCK
CHAIRMAN
COMMITTEE ON INSTRUCTION

AMERICAN OPTICAL COMPANY INVITES ACADEMY MEMBERS

Members and guests attending the annual meeting of the Academy at Boston, December 10-16, 1958, who wish to visit the American Optical Company at Southbridge, Massachusetts, should leave their names and hotel room numbers at the convention registration desk. Arrangements will be made for a trip to Southbridge, leaving the hotel at 9:00 a. m. on Wednesday, December 17, and returning to Boston in time for dinner the same evening. For members who have never had the opportunity of visiting a large optical manufacturing plant, this is a splendid time to do so and the American Optical Company people are hopeful that many members will come to Southbridge for the day.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

PROGRAM
AMERICAN ACADEMY OF OPTOMETRY

Statler-Hilton Hotel
Boston, Massachusetts
Post-Graduate Courses, December 10, 11 and 12, 1958
Annual Meeting of the Academy, December 13, 14, 15 and 16, 1958

WEDNESDAY, THURSDAY and FRIDAY, December 10, 11 and 12, 1958.

8:00 A. M. to 10:00 P. M. American Academy of Optometry Post-Graduate Courses.* Apply at Registration Desk for tickets and program.

10:00 A. M. to 9:00 P. M. American Academy of Optometry, Executive Council meetings. See Bulletin Board for Room number. All Academy members welcome to attend sessions.

FRIDAY, December 12, 1958.

9:30 A. M. to 4:00 P.M. American Academy of Optometry, Committee on Admittance. Applicants meet with Committee on Admittance to complete their Clinical Examinations. See Bulletin Board for Room number.

SATURDAY, DECEMBER, 13, 1958

8:30 Registration.

10:00 Business Meeting.

President's Annual Report. Robert W. Tubesing, O.D.

Secretary's Annual Report. Carel C. Koch, O.D.

Announcements by Chairman of the Papers and Program Committee. Ralph E. Wick, O.D.

Announcements by Chairman of the Sections, under the direction of Donald Springer, O.D.

Monroe J. Hirsch, O.D., Ph.D. Section on Pathology.

Bernard Mazow, O.D. Section on Contact Lens Fitting and Sub-Normal Vision.

O. L. McCulloch, O.D. Section on Aniseikonia and Refractive Problems.

Herman Seger, O.D. Section on Occupational Optometry.

John Zettel, Jr., O.D. Section on Orthoptics.

10:40 Some Genetic and Environmental Implications Resulting from a Study of the Corneal Curvatures and Refractive Status of Identical and Fraternal Twins.

R. J. Wixson, O.D., Shamokin, Pennsylvania.

11:05 Discussion.

11:10 The Orinda Vision Study.

Henry B. Peters, M.A., O.D., School of Optometry, University of California, Berkeley.

Henrik L. Blum, M.D., M.P.H., Health Officer, Contra Costa County; Stanford University Medical School; Lecturer in Public Health, University of California, Berkeley.

Jerome W. Bettman, M.D., Stanford University Medical School, San Francisco.

11:40 Problems and Compromises in the Design of Aspheric Cataract Lenses.

John K. Davis, A.B., New Product Development Department, American Optical Company, Southbridge, Massachusetts.

12:00 Discussion.

12:05 Luncheon Recess.

1:30 Further Studies on the Relationship Between Amblyopia and the Stiles-Crawford Effect.

*For a detailed review of these 55 courses see following: Vincent J. Ellerbrock, *et al.* Post-Graduate Courses of the American Academy of Optometry. Am. J. Optom. & Arch. Am. Acad. Optom. 35.8.439-448, 1958.

Jay M. Enoch, O.D., Ph.D., Washington University, St. Louis, Missouri.

1:55 Discussion.

2:00 Development of the Army's Occupational Vision Program.
Robert E. Eschbach, O.D., Captain, Medical Service Corps Chief, Occupational Vision Branch, U. S. Army Environmental Health Laboratory, Army Chemical Center, Maryland.

2:25 Discussion.

2:30 Accommodation-Convergence Relations at the Near-Point of Convergence.
Glenn A. Fry, O.D., Ph.D., School of Optometry, Ohio State University, Columbus, Ohio.

2:55 Discussion.

3:00 Changes in Astigmatism After the Age of Forty.
Monroe J. Hirsch, O.D., Ph.D., Ojai, California.

3:25 Discussion.

3:30 The Accessory Optic Tracts—A Review.
Duco Hamasaki, O.D., University of California, School of Optometry, Berkeley, California.

3:55 Discussion.

4:00 A Keratoscopic Survey of 13,395 Eyes.
H. W. Hofstetter, O.D., Ph.D., Indiana University, Division of Optometry, Bloomington, Indiana.

4:25 Discussion.

4:30 Further Aspects of Blurring and Color Discrimination.
Arthur Shlaifer, O.D., Ph.D., Pennsylvania State College of Optometry, Philadelphia, Pennsylvania.

4:50 Discussion.

4:55 Accommodative Fatigue in the Aging Radar Oberver.
Jerome A. Hirsch, O.D., Captain, U.S.A.F. (MSC), Dayton, Ohio.

5:15 Discussion.

SUNDAY, DECEMBER 14, 1958

9:00 Section Meetings.

11:10 Tonometry.
John H. Carter, O.D., Indiana University, Division of Optometry, Bloomington, Indiana.

11:30 Discussion.

11:35 Empirical Corrections for Aniseikonia in Pre-School Anisometropes.
Robert J. Davis, O.D., Henderson, Kentucky.

11:55 Discussion.

12:00 Visual Recovery Times for High Intensity Flashes of Light.
Robert D. Metcalf, O.D., Captain, U.S.A.F. (MSC), Dayton, Ohio.

12:20 Discussion.

12:25 Luncheon Recess.

2:00 Contact Lens Symposium.
Bernard Mazow, O.D., Moderator, Houston, Texas.

Teminology and characteristics of lenses currently in use.
Robert Graham, O.D., Pasadena, California.

Physiology of the Cornea as applied to contact lens fitting.
Isidore Finkelstein, O.D., Ph.D., New York City, New York.

Recess.

Technique of fitting.
John C. Neill, O.D., Philadelphia, Pennsylvania.

Inspection of lenses received from laboratory and care of lenses by the patient.
William Policoff, O.D., Wilkes-Barre, Pennsylvania.

Economics.
Irving P. Filderman, O.D., Memphis, Tennessee.

5:00 Discussion.

5:45 Dinner Recess.

7:45 Analogs and Models of the Human Visual System.
Leon D. Harmon, Bell Telephone Laboratories, Murray Hill, New Jersey.

8:10 Discussion.

8:15 Problems of Vision in Aviation.
T. C. D. Whiteside, Squadron Leader, Ph.D., M.B., Ch.B., Royal Air Force Institute of Aviation Medicine, Farnborough (Hants), England.

8:40 Discussion.

8:45 Optometry and Audiology.
Kenneth O. Johnson, Ph.D., Executive Secretary, American Speech and Hearing Association, Washington, D. C.

9:05 Discussion.

MONDAY, DECEMBER 15, 1958

9:00 Section Meetings.

11:10 Relationship Between Refractive Findings and Design of Refracting Rooms.
Frederick W. Hebbard, O.D., Ph.D., School of Optometry, Ohio State University, Columbus, Ohio.

11:35 Discussion.

11:40 The Relationship of Refractive Status of Selected Personality and Adjustment Factors.
Melvin C. Nadell, O.D., Ph.D., Los Angeles College of Optometry, Los Angeles, California.

12:00 Discussion.

12:05 Luncheon Recess.

1:15 Depth Perception and Selected Industrial Accidents.

George C. Hill, O.D., Industrial Optometrist, Portsmouth, Virginia.

1:35 Discussion.

1:40 The Influence of Kinesthesis Upon Near Heterophoria Measurements.
Floyd M. Morris, O.D., Major, U.S.A.F. (MSC), School of Aviation Medicine, Randolph Air Force Base, Texas.

2:05 Discussion.

2:10 Comparative Techniques in Perimetry.
Ira Schwartz, O.D., U.S.N., Medical Research Laboratory, New London, Connecticut.
Patricia A. Kelsey, B.A., U. S. Naval Submarine Base, New London, Connecticut.

2:35 Discussion.

2:40 The Relationship Between Angle Lambda and the Residual Astigmatism of the Eye.
Lester R. Loper, O.D., Optometry Officer, U.S.A.F., Randolph Air Force Base, Texas.

3:00 Discussion.

3:05 The Use of Eye Movement Photography in Office Practice.
Harold A. Sloan, O.D., Visual Consultant, Reading and Study Skills Center, New York City.

3:25 Discussion.

3:30 Signal Recognition by Color Defective Observers.
Ingeborg Schmidt, M.D., Indiana University, Division of Optometry, Bloomington, Indiana.
Gordon G. Heath, O.D., Indiana University, Division of Optometry, Bloomington, Indiana.

3:55 Discussion.

4:00 Business Meeting.
Robert W. Tubesing, O.D., Presiding.

6:00 Cocktail Hour.

7:00 Annual Roundtable Dinner.

Introduction of New Fellows by Harold Simmerman, O.D.

Phi Theta Epsilon Fraternity Memorial Award.

The State of the Optometric Profession.
Hoyt S. Purvis, O.D., President, American Optometric Association, Jonesboro, Arkansas.

Relationship of Vision to Learning.
Thomas H. Eames, O.D., Ed.M., M.D., Department of Education, University of Boston, Boston, Massachusetts.

TUESDAY, DECEMBER 16, 1958

9:00 Section Meetings.

11:10 Influence of Illumination Level on Near-Point Tests.
Frederick W. Hebbard, O.D., Ph.D., School of Optometry, Ohio State University, Columbus, Ohio.

11:35 Discussion.

11:40 The Use of High Add Bifocals in Cases of Low Visual Acuity.
John Zettel, Jr., O.D., Cincinnati, Ohio.

12:05 Discussion.

12:10 Luncheon Recess.

1:15 The Transmission of the Visible Spectrum Through the Ocular Media of Bovine Eyes.
Donald G. Pitts, O.D., Captain, U.S.A.F., Institute of Technology, Indiana University, Bloomington, Indiana.

1:35 Discussion.

1:40 Refractive Techniques for the Decreased Vision Problems of the Aged.
Harry Kaplan, O.D., Pennsylvania State College of Optometry, Philadelphia, Pennsylvania.

2:05 Discussion.

2:10 Interrelations of Visual Measures.
Francis A. Young, Ph.D., Department of Psychology, State College of Washington, Pullman, Washington.

2:30 Discussion.

2:35 Haptic (Scleral) Contact Lenses: Their Place in the Contact Lens Field.
Harold I. Moss, O.D., Wilmington, Delaware.

2:55 Discussion.

3:00 Finale of Project 650—(Special Print for Sub-Normal Vision).
Jack H. Prince, F.B.O.A., F.R.M.S., (Eng.), Ohio State University and Institute for Research in Vision, Columbus, Ohio.

3:25 Discussion.

3:30 A Preliminary Study of Patient Referrals.
Wm. G. Walton, Jr., O.D., Pennsylvania State College of Optometry, Philadelphia, Pennsylvania.

3:55 Discussion.

4:00 Adjournment.

RALPH E. WICK, O.D.
PROGRAM CHAIRMAN

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

OPPORTUNITY FOR NAVAL RESERVE COMMISSION

The Recruiting Service of the Navy has been authorized to recruit qualified applicants for consideration for indoctrination and appointment, under the Officer Candidate School Program, as Reserve officers in the grade of Ensign or LT (junior grade) in the Medical Service Corps, Optometry Section.

Due to the limited number of openings, interested applicants should take immediate action toward applying for commission. Prime consideration will be given to those applicants requesting a minimum of three years' active duty. Applications for Reserve commissions, inactive duty status, are not desired.

Applicants must be at least 21 and under 31½ years of age at time of submission of application for appointment in the grade of Ensign and under 33 years at time of submission of application for appointment in the grade of Lieutenant (junior grade). He must be a graduate of an accredited college or university with a major (30 semester hours) in Optometry for a commission as Ensign. For appointment in the grade of Lieutenant (junior grade), the candidate must have earned a Doctor of Science or Philosophy degree. Candidates must submit evidence of registration as an optometrist by one of the states or the District of Columbia.

Further information can be obtained from any Office of Naval Officer Procurement, the Commandants of Naval Districts, or from the Bureau of Medicine and Surgery, Navy Department, Washington 25, D. C.

ACTIVE DUTY REQUESTS FROM RESERVE OFFICERS

Naval Reserve officers of the Medical Service Corps, Optometry Section, in the rank of Ensign or Lieutenant (junior grade), currently in an inactive duty status, may request active duty by applying to the Chief of Naval Personnel via official chain of command and via the Bureau of Medicine and Surgery. Paramount consideration will be given requests for a minimum of three years' active duty.

Something of Value

The birth of contact lenses from the time of its conception has been a wonder to behold. It has indeed been a short time from its conception, gestation, and birth. It behooves us to study each one of the many facets of this infant.

For years we have noticed the need for adequate fees in contact lens work. Contact lenses are priceless and command a commensurate fee. This work must be truly done on a high professional plane. Those who have tried to cheapen contact lenses soon found their contact lens work diminished.

In addition, do not forget the great amount of charity work that must be done . . . most of the time without charge. We in the laboratory have recognized this and have made up lenses without charge on your say-so whenever this was necessary. Wherever you have lowered your fee on these charity cases, we have proportionately done the same at the laboratory level. In this manner many subnormal vision cases have been helped to resume their work in a normal world.

Those of us who have grown old in this work realize more than ever that patience, skill, knowledge, motivation, psychology, dedication and many other fine traits are necessary for the continued success and growth of a contact lens practice. The mere thought of placing something on the eye is a great deterrent in the fitting of contact lenses. Time and patience are required to fit a contact lens patient if everything goes well. We know the time and skill required will have to be increased tenfold if the case is difficult. Too many forget the time required in patient follow-ups.

Not only is there a tremendous responsibility upon the practitioners but also on the laboratories. This is especially true in grinding and polishing plastic which is a difficult medium to handle. Contact lenses are constantly being made smaller and thinner with the addition of many secondary curves. Molding involves tremendous investment and research. All these factors require a greater skill in maintaining tolerances. We know that these changes are exacting and costly today in the manufacturing process but we do not spare time nor money in order to aid progress.

This teamwork between the practitioner and the laboratory is an important one for the patient, and we will do everything possible to uphold our part.

Let's solve our contact lens problems together for the benefit of all mankind.

THE CONTACT LENS CIRCLE W/J

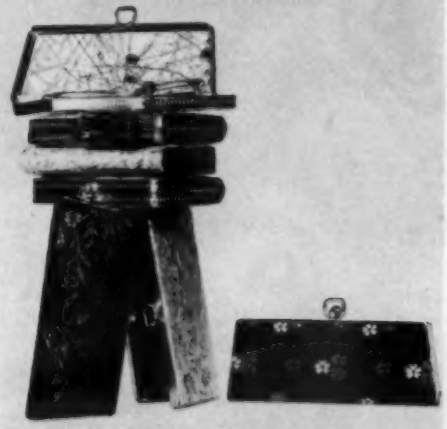
To the center of your contact lens problem

the Plastic Contact Lens Company

59 EAST MADISON STREET • CHICAGO 3, ILLINOIS

"Dedicated to Knowledge and Research"

FOR THE FINEST TASTE: A metal frame pocketbook case in royal brocade, cynthia brocade, houndstooth checks, colored and grained vinyls, and new transparent vinyl laminated with spring flowers and gold and silver threads. The smart pocketbook case also affords special protection for trimmed frames. Write for free sample and sample swatches showing all materials available. KELLEY & HUEBER, INC., 4052 Haverford Avenue, Philadelphia 4, Penna.



KELLEY & HUEBER, INC. • Serving the optical industry since 1849

WATCHEMOKET
optical accessories

"STANDARD OF THE INDUSTRY"

BLACKOUT RETRAINING INSTRUMENT

For retraining eyes after retinal detachment operations . . . all plastic construction . . . staggered pinhole openings with P. D. range of 58 mm to 73 mm . . . "Blackout" lens and frame exclude light which weakened retina cannot comfortably accept . . . deep frame accommodates surgical dressings.

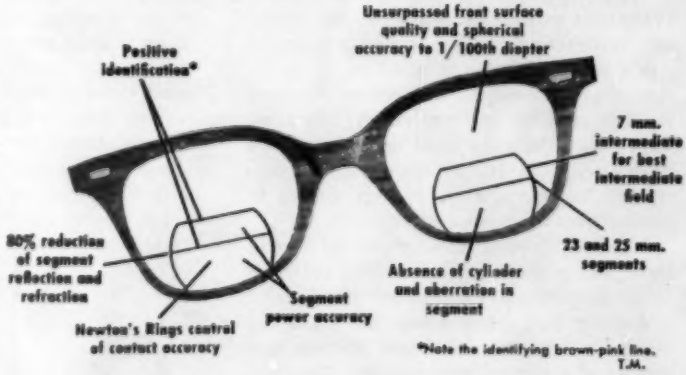
WATCHEMOKET eye SAVERS

WATCHEMOKET OPTICAL CO., INC.
232 West Exchange Street • Providence 3, R. I.

Rx Continuous Vision at its Univis best!

Univis
Nu-Line T.M.
7 CV

NOW . . .
AS ALWAYS . . .
CORRECTED CURVES


Unsurpassed front surface quality and spherical accuracy to 1/100th diopter
Positive identification*
7 mm. intermediate for best intermediate field
80% reduction of segment reflection and refraction
23 and 25 mm. segments
Absence of cylinder and aberration in segment
Segment power accuracy
Newton's Rings control of contact accuracy

*Note the identifying brown-pink line. T.M.

A COMPLETE Rx SERVICE **Twin City** OPTICAL COMPANY

MINNEAPOLIS • MINNESOTA • WILLMAR

For A Better Look...

Teddie Deluxe by Victory

New . . . smart . . . flattering . . . and featherlight — that's Teddie Deluxe, another eyecatching original by Victory. The beauty of this frame is tastefully enhanced by rich, two-tone hand engraving at temples and browline . . . and by rich colors in these combinations: Brown & Gold, Slate & Silver, Gold & Blue, Black & Silver, Silver & Gold, Slate & Smoke, Brown & Cognac, Silver & Taupe.

MINNESOTA OPTICAL COMPANY

Exclusive Supplier — for the Profession

621 West Lake St.
Minneapolis 8, Minnesota

Glover FRAME CABINETS

FITTING DESKS
FRAME BARS
OTHER DISPENSING ITEMS

They are all designed to meet your specific needs.

Write for complete information.

GLOVER MANUFACTURING CO.
Box 4093 Austin 51, Texas

GLOVER product

WALCO

SINCE 1915

COMPLETE OPHTHALMIC
Services
to the PROFESSION

- *Precision* GRINDING
- *Quality* MATERIALS
- *Craftsmanship*

CONVENIENTLY LOCATED
St. Paul, Minn. • Austin, Minn. • Bemidji, Minn.
Watertown, S.D. • Grand Forks, N.D.

THE WALMAN OPTICAL COMPANY
229 Medical Arts Building Minneapolis 2, Minnesota
FOUNDED IN NINETEEN HUNDRED FIFTEEN

NOW AVAILABLE TO THE OPTOMETRIC PROFESSION:

THE WOLFE TONOMETER

The use of the Wolfe Scleral Tonometer has been validated for the measurement of increased intra-ocular pressure as in glaucoma.

It may be used for the detection of abnormal diurnal variations, marked differences in comparative pressure of the two eyes and in conjunction with optometrically applied provocative tests, all indicative of incipient glaucoma.

A brochure describing the specific instrumentation and summary of research will be sent upon request.

The Wolfe Tonometer is available in limited quantities, and may be purchased directly.

$46.50
F.O.B. CHICAGO

DEPARTMENT OF CLINICAL RESEARCH

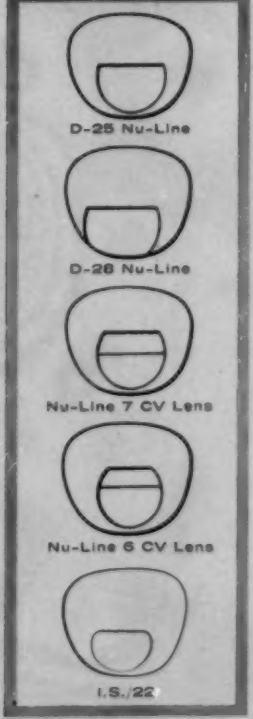
Illinois College of Optometry

Technology Center

3241 SO. MICHIGAN AVE., CHICAGO 16, ILLINOIS

You don't guess, you **Know**

with the Univis **LABEL LINE** of fine multifocal lenses



When you prescribe from the Univis LABEL LINE of fine multifocals, the naked eye shows you have Univis — that patients are receiving the ultimate in good vision, the most accurate representation of a careful prescription.

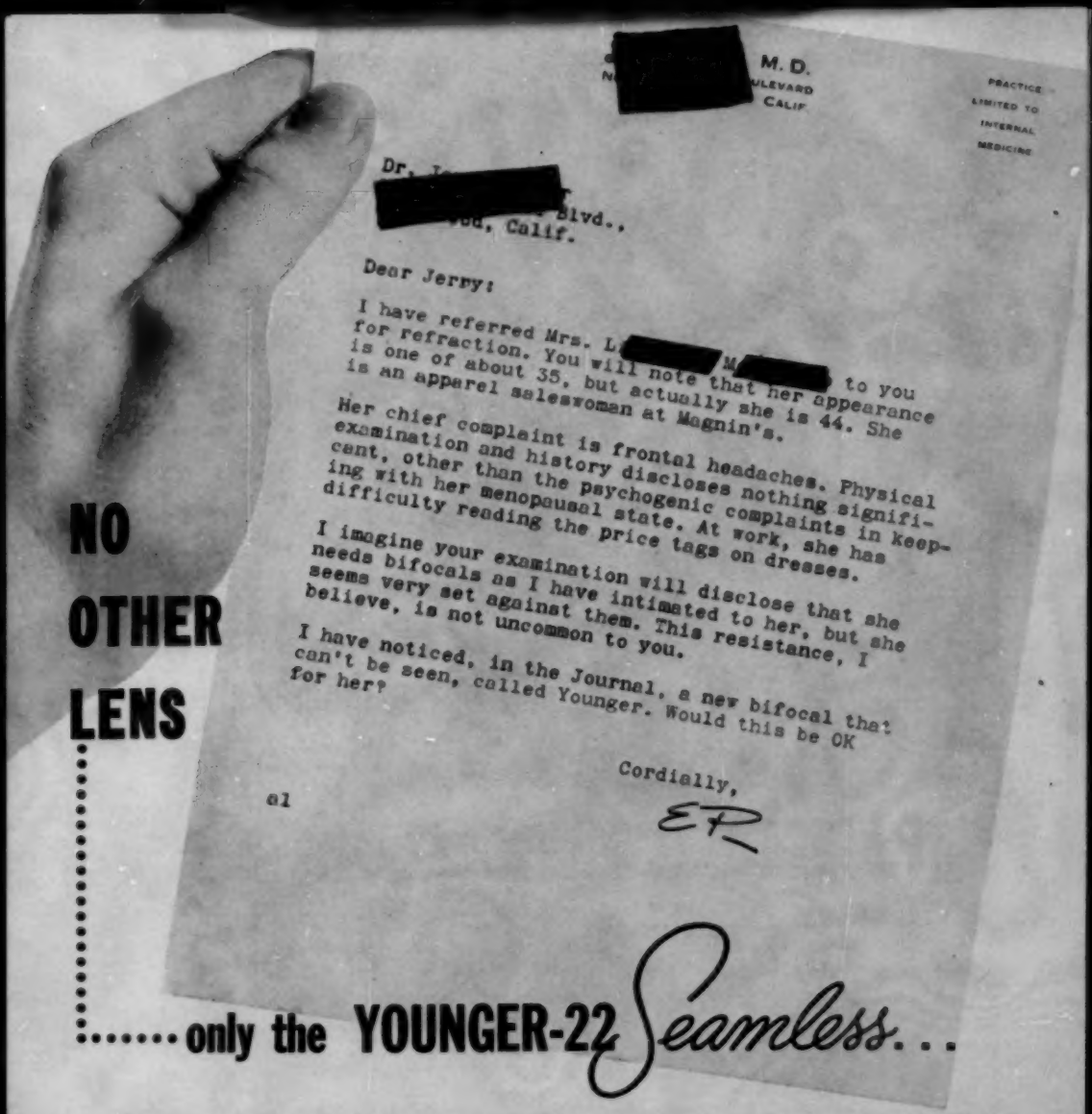
Select from Nu-Line® treated* D-25 or D-28 bifocals, Nu-Line 7 CV® or Nu-Line 6 CV lenses; or choose the distinctive Univis I.S./22, the "secret" segment bifocal with straight-top segment and rounded corners. Whichever you decide upon, you'll be using a lens with a difference — a difference you can *see*.

**Note the faint brownish-pink line.*

Corrected curves, of course

The UNIVIS Lens Company

Dayton, Ohio


M. D.
BOULEVARD
CALIF
PRACTICE LIMITED TO INTERNAL MEDICINE
Dr.
Blvd.,
Calif.
Dear Jerry:
I have referred Mrs. L to you for refraction. You will note that her appearance is one of about 35, but actually she is 44. She is an apparel saleswoman at Magnin's.
Her chief complaint is frontal headaches. Physical examination and history discloses nothing significant, other than the psychogenic complaints in keeping with her menopausal state. At work, she has difficulty reading the price tags on dresses.
I imagine your examination will disclose that she needs bifocals as I have intimated to her, but she seems very set against them. This resistance, I believe, is not uncommon to you.
I have noticed, in the Journal, a new bifocal that can't be seen, called Younger. Would this be OK for her?
Cordially,
al

NO OTHER LENS

.....only the YOUNGER-22 *Seamless*...

can give this patient the optics and psycho-therapy indicated!

The presbyopic age of women usually coincides with the 'change of life', which in almost every case, manifests itself by varying degrees of neurosis. These unhappy beings realize that they have reached the pinnacle of womanhood and feel they are now in a decline. They are extremely conscious of their age and appearance, and any further emphasis of the inevitable aging process . . . such as prescribing an ordinary age-revealing visible bifocal . . . is added shock to the already existent neurosis.

The Younger-22 Seamless Lens is particularly indicated for the reluctant presbyope who, on being told they need bifocals, insist instead on a pair of reading glasses. Only Younger Lenses will overcome this resistance in the majority of cases.

The fact that Younger-22 Seamless Lenses allow the patient clear, comfortable vision for both reading and distance without any confusing or age-revealing dividing line, has a dramatic psychological appeal to those ophthalmic neurotics who resist bifocals for any reason.

YOUNGER MANUFACTURING COMPANY • Los Angeles 15, California